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ADJUSTING PEDAGOGY TO OPTIMISE NEGOTIABILITY AND INTERACTIVITY IN LESSONS USING THE INTERACTIVE WHITEBOARD: AN ACTION RESEARCH STUDY IN A PRIMARY SCHOOL

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for the Degree of Master in Education

in Information Communication Technology

Cheryl Jaftha (JFTCHE001)

Supervisor: Associate Professor Cheryl Hodgkinson-Williams

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Abstract

In both developed and developing countries, governments have been encouraging the use of information communication technologies (ICTs) to support education. Many types of ICTs are available on the market and can be used in support of teaching and learning and have been deployed with greater or lesser success in education environments. One of the recent technological devices that have been introduced in the educational domain is the interactive whiteboard (IWB). IWBs have become established teaching and learning tools, particularly in primary school classrooms in developed English speaking countries and have more recently been deployed in developing countries such as South Africa. The Western Cape Province in South Africa has rolled out a province-wide IWB programme over the last decade, despite limited local research on the pedagogical value of IWBs in South African schools.

This research study aims to investigate how the IWB can be used to encourage collaboration amongst the learners in a Grade 6 Technology Education class at a primary school in the Western Cape and specifically to assist the teacher in understanding how her pedagogy needs to change to optimise learner collaboration in association with an IWB.

To understand the ways in which the IWB influences the activities in the classroom, Activity Theory is used as a framework to understand the tensions that arise and how the teacher needs to change her pedagogical strategies to successfully resolve these tensions. This investigation builds on the work of Sweeney (2010) and Zevenbergen and Lerman (2008). The research is based on an interpretivist epistemology that examines an authentic experience, reviewing activities on the IWB while evaluating opinions expressed in journal writing, observations, questionnaires and interviews with the focus group who manipulated the IWB as a tool to encourage collaboration amongst learners. Core concepts of *physical interactivity* (Jewitt et al., 2007) and *negotiability* (Dillenbourg 1999), within a collaborative setting as well as understanding *emergent* and *imposed* structures (Biott & Easen 1994), and their impact on collaborative learning are investigated. A modified version of Zuber-Skerrit's (1992) Action Research model is used as a methodological framework.

The findings suggest that the resolutions of the major contradictions are crucial for the change in teachers' pedagogical approaches for the effective infusion of the IWB in the educational domain. Pedagogical strategies adopted by the teacher and the appropriate selection of functions of the IWB are key aspects that will enhance collaboration amongst learners.

Key words: Interactive whiteboards (IWB); Collaborative learning; Negotiability; Physical interactivity; Emergent and Imposed structures Activity theory; Action Research

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Plagiarism Declaration

I, Cheryl Jaftha, hereby declare that the work contained in this dissertation is my own work and that it has not been submitted for any degree or examination at any other university.

Signed: Date: September 2012

Declaration by candidate for the degree of Master in the Faculty of Humanities

I, Cheryl Jaftha of 07 Hanekraai Street, Pellissier, Bloemfontein, do hereby declare that I empower the University of Cape Town to produce for the purpose of research either the whole or any portion of the contents of my dissertation entitled *Adjusting pedagogy to optimise interactivity and negotiability in lessons using the IWB in a primary school: An Action Research Study* in any manner whatsoever.

Signed

Date

Contact:
Cheryl Jaftha

7 Hanekraai Street

Pellissier

Bloemfontein

9300

cjaftha@cut.ac.za

cheryl.jaftha@gmail.com

Abbreviations:

AT	Activity Theory
CL	Collaborative Learning
ICT/s	Information Communication Technology/Technologies
IWB/s	Interactive Whiteboard
WCED	Western Cape Education Department
ZPD	Zone of Proximal Development

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Chapter 1: An overview of the study

1.1 Introduction

Information communication technologies (ICTs) are crucial for all spheres of our existence, therefore citizens need to be ICT literate in order to participate effectively in society and so that economic and social goals can be attained and innovative capacity be built (Tella and Adu 2009). ICT literate citizens will be able to access, manage and evaluate information, develop new understandings and communicate and collaborate more efficiently in the global society (Tella and Adu 2009).

Due to the widespread diffusion of ICTs in the modern digital society it is impossible to visualise future learning environments which are not supported by ICTs (Punie, Zinnbauer & Cabrera 2008). Punie et al. (2008:6) noted that:

> "educational achievements are not only shaped by the way education is organised, but also by the socio-economic background of learners and their socio-cultural environments and by changing skills and competences required for employment, education and training, self-development and participation in society".

From a developed country's perspective the Curriculum Corporation's statement of learning (2006, as cited by Tella and Adu 2009:55) mentioned the following advantages of using ICTs as a tool to enhance learning. Firstly, incorporating ICT as a support tool for learning enables students to: "efficiently and effectively access digital information to assist with investigating issues, solving problems and decision making" (Tella and Adu 2009:55). Furthermore, they also stated that using ICT to enhance education also produces innovative solutions to support learning and develop new perceptions in areas of learning as well as communication, sharing and working collaboratively in the local and global environment. In addition, they also noted that incorporating ICT as a support tool for learning develops new reasoning and learning skills (Tella and Adu 2009).

In developed countries (for example countries with the European Community, the USA and Australia) ICTs are mostly used in the education domain as support tools and to enrich the existing learning process and its administration rather than for their transformative potential (Punie et al., 2006). Dillon and O'Rourke (2008:22) mentioned that ICT can be used to provide "active, co-operative, peer-based

learning; encourage critical thinking skills; engage the students in higher-order thinking skills and promote autonomous learning".

Wong, Li, Choi and Lee (2008) noted similar aspects when ICT was implemented in Hong Kong (a developed part of China) and according to their findings, ICT acted as a tool to support teaching and learning and had a fair influence on changing the curriculum content and pedagogy. The authors also stated that "the use of ICT supports exploratory activities designed by teachers, and facilitates pupils to construct knowledge collaboratively and to express ideas" (Wong et al., 2008: 261).

In the developing context, the Education Support Network Project (ESNet) launched a project where ICT was implemented in schools in Zambia and they noted the following benefits (Chicomba, Koopman & Stanton 2009): ICTs improved the editing cycle of written teaching resources, enabled the expansion of the distribution channel-sharing of educational resources and facilitated the upgrading of existing teaching notes in schools (Chicomba et al., 2009). It was noted by Farrell and Isaacs (2007:17) that the formal school sector has led the way to incorporating ICTs in education in most African countries even before national policies were adopted. They also mentioned that a significant characteristic of national ICT and ICT for education policies in African countries (such as South Africa and Botswana) was the promotion of computer science or information technology as a school-based subject in addition to the access, use and implementation of ICT within the school system.

1.2 The interactive whiteboard (IWB)

The IWB is a large, touch-sensitive board that is connected to a computer and a digital projector. The projector displays the image from the computer on the board. The computer can be controlled by touching the screen directly or with a special pen (Becta 2003). The IWB, also known as electronic or digital white board, was first introduced as a presentational tool for corporate environments (Higgins, Beauchamp & Miller 2007). Thereafter it was used in higher educational institutions and as a result of the IWB's potential as a presentational tool and the numerous affordances attached to it, the IWB was introduced in primary schools (Higgins et al., 2007).

IWBs have become established teaching and learning tools, particularly in primary school classrooms in developed English speaking countries (Northcote, Mildenhall & Swan 2010). However, research about the use of IWBs in English speaking countries has focused on *teacher* use rather than on *student* use (Northcote et al., 2010).

In the South African context, Slay, Siebörger and Hodgkinson-Williams (2007) conducted a feasibility study in the Eastern Cape to determine the potential benefits and drawbacks IWB use in schools. Their study demonstrates the disruptive consequences that technology can have when not fully understood or used optimally. They cautioned "against imposing technologies on teachers and suggest instead that teachers be allowed to request the technologies they deem suitable to support their pedagogical evolution in the teaching domain" (Slay et al., 2007:19). They discovered that the educators did not use the IWB regularly but only when the researchers were present. It was also discovered that even though teachers spoke positively about the motivational benefits of the up-to-date technology for learners, they did not utilise the interactivity of the IWB optimally. Slay et al. (2007) also suggested that an evolution of pedagogy has to occur in order to employ the IWBs optimally. According to Slay, Siebörger and Hodgkinson-Williams (2008) pilot roll-outs of IWBs were undertaken in schools in the Eastern Cape as well as in the Western Cape.

In the Western Cape, the then manager of the Khanya project, Kobus van Wyk, oversaw the implementation of 2300 IWBs (Khanya Report 2008). The Khanya Project was an initiative of the Western Cape Education Department and it was established in April 2001 to determine the contribution that technology could make towards addressing the increasing shortage of educator capacity in schools. One of these alternatives was to use technology, already being used extensively in other disciplines, as an aid to augmenting teaching capacity (Khanya Report 2008). The Khanya Project came to an end on 28 September 2011 and was handed over to the new custodians of the Western Cape Education Department's Information and Communications Technology (ICT). One billion Rands' worth of computer laboratories has been installed at schools in the Western Cape, according to the Khanya Report (2012).

Chigona and Mooketsi (2011) presented an explicit view of ICT implementation in the Western Cape, South Africa. They stated that the media painted a distorted view of the Khanya project and that the project was "romanticised and the limitations and challenges of ICT (specifically the IWB) and its impact on education in South Africa were under-represented" (Chigona and Mooketsi 2011:13). Chigona and Mooketsi (2011) discovered that even though the Khanya project claimed that the use of technology in education enhances learning, none of the articles on the Khanya website could provide statistical or observed evidence of the improved results. According to them, to validate the use of the IWB at a school the Khanya Project mentioned that:"*recent research has shown the use of technology in classrooms has boosted pupils' marks, improved attention span and interaction during lessons".* However, no details of the context of the quoted research were provided (Chigona and Mooketsi 2011:8).

From a developed country's perspective Thornley (2010) also noted the different types of "interactivity" (as cited by Jewitt et al., 2007) namely *physical, technical* and *conceptual interactivity.* Thornley (2010) suggested that an essential requirement for using the IWB technology in the classroom is an understanding of how teaching influences student learning. Furthermore, if teachers comprehend what impact their teaching has on learning, they will be able to develop teaching strategies that utilise the IWB affordances efficiently and contribute to a deeper learning experience for learners (Thornley 2010). In addition, she also emphasised that a new learning model is needed for use of technology in education, specifically with regard to the role that technology plays in broadening the learning content available to learners and relieving the teacher of being the exclusive specialist in the classroom (Thornley 2010).

The IWB has been applauded in British schools with emphasis on the following aspects: more opportunities for teacher-pupil interaction (Smith, Harman & Higgins 2006); capacity for collaboration, versatility and inspiring teachers to change pedagogy. Torff and Tirotta (2010) and Zevenbergen and Lerman (2008) noted that motivation levels of learners were elevated when employing the IWB in educational settings. Higgins et al. (2007) cited the quickening of the pace of lessons when using the IWB. Smith, Higgins, Wall and Miller (2005) and Higgins et al. (2007) mentioned the value of "multi-media resources" which are beneficial for learners with special needs to assist them in both processing and the retention of information. Kennewell and Beauchamp (2007) stressed the role of IWBs in the conversion of pedagogy toward more learner-centeredness.

Dillenbourg (1999:2), Biott and Easen (1994) and Golub (1988) noted that using the IWB as a pedagogic tool promotes collaborative learning within the classroom. The same fact was noted by SMART Technologies (2004:5, as cited by Mahon 2008). Dillenbourg (1999:7) suggested that: "Collaborative learning refers to a 'situation' in which particular forms of interaction among people is to take place, which would trigger learning, but there is no guarantee that the expected interactions will actually occur". In a quest to determine whether the IWB is really as effective in encouraging collaborative learning as mentioned by the above researchers, this research endeavoured to investigate how the use of an IWB as a tool will elicit collaborative learning amongst Grade 6 learners in Technology Education.

There has been much discussion about the IWB's high level of interactivity 'physical manipulation' of the board which leads to increased motivation amongst the pupils (Becta 2003:3). It is also acknowledged that the IWB's interactive features allow the educator as well as the pupils to engage, which in turn encourages group-based exchanges (SMART Technologies 2004:5 as cited by Mahon 2008). In addition,

Higgins et al. (2007) maintained that educators play crucial roles in mediating and encouraging quality interaction amongst the pupils while they are manipulating (i.e. interacting with the technical facilities) the IWB.

Furthermore Higgins et al. (2007) noted that the IWB increased the interactivity where the educator moved from an instructional role to using the IWB as a tool to incorporate and extend interactive learning. Higgins et al. (2007) also noted the increasing acknowledgment that teaching is a multi-faceted activity and it draws on a variety of modalities such as verbal, visual and interpersonal communication.

In a developing context, South Africa followed suit, hoping to achieve the same benefits as the developed countries such as Australia (Zevenbergen & Lerman 2008) and New Zealand (Thornley 2010).

Empirical research conducted by Zevenbergen and Lerman (2008) in a Mathematics class in a primary schools in Australia showed that the IWB has the potential to enhance learners' mathematical thinking and affords opportunities to experience mathematical representations. Different learning styles can be accommodated using the IWB as a tool and this was also noted by Becta (2003) and Higgins et al. (2007). Smith et al. (2005) referred to "interactivity and participation" brought about by the IWB while Warwick, Mercer, Kershner and Staarman (2010) mentioned "learner engagement" or "learner-group interaction" and stated that "learner-group interaction must be skillfully manipulated."

The theoretical perspective adopted by Zevenbergen and Lerman (2008), namely Activity Theory, suggests that "Technology is mediated by pedagogy, collaboration, shift from teacher to student and activity theory". Zevenbergen and Lerman (2008) concluded that the IWB, used as the technological tool, was mediated by pedagogy. This research will be using the same theoretical lens as Zevenbergen and Lerman (2008) to understand how the use of the IWB as a tool will mediate my pedagogy in the Technology learning area.

According to Zevenbergen and Lerman, "whole class interaction may stifle participation (and engagement) of students" (2008:124), but the teacher's pedagogy can be modified to elicit collaboration when smaller groups are formed. They also suggested that other strategies should be used along with the IWB to encourage more interaction. I plan to employ pedagogical strategies which include instructions, lesson designs, group structures and assessments in order to encourage more collaboration amongst the learners, as my study seeks to investigate how the IWB can be used as a tool to encourage collaborative learning.

Sweeny (2010) used Activity Theory as a framework to demonstrate major contradictions in the implementation and use of IWB to support student learning. The resolution of these major contradictions is crucial for the teachers' effective use of the IWB.

The focus of this study is on the use of the IWB as this is one of the latest ICT devices that have been rolled out in the South African educational contexts, particularly in the Western Cape. In the present investigation the focus shifts from the teacher-directed to the learners who will be manipulating the IWB.

1.3 Rationale

In the South African context, Chigona and Mooketsi (2011) have conducted research of IWB use in the Western Cape and Slay et al. (2008) in the Eastern Cape. However, no independent research has been conducted on the use of the IWB and its use in the fairly new learning area; Technology which was introduced with Outcomes-based Education in 2005. As a Technology teacher endeavouring to use ICTs to support my teaching and collaboration amongst my learners, I deemed it worthwhile to undertake this investigation to determine what impact IWB use will have on encouraging learner collaboration in the Technology Learning Area and specifically on how I might need to adapt my pedagogy to ensure optimum use of the IWB.

According to the Revised National Curriculum Statement Grades R-9 (Schools), Technology Education can be defined as the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems while considering social and environmental factors (Department of Education 2002).

The study represented in this dissertation was conducted at a disadvantaged, multilingual and multiracial school in the Western Cape. The grades range from Grade R to Grade 7 and each class has more or less 46 learners. I taught Technology Education to Grades 4-7 at the school since it was introduced as a new learning area in 2002.

To reiterate, my study builds on the research of Sweeny (2010) and Zevenbergen and Lerman (2007) in Australia, Slay et al. (2007) who studied the impact of IWB implementation in schools in South Africa, and Chigona and Mooketsi (2011:1) who analysed "the media discourse on ICT for Development ICT4D projects in developing countries ". The purpose of my study is to investigate how I need to adjust my

pedagogy to optimise and support collaborative learning and specifically focusing on interactivity and negotiability in lessons using the IWB in a primary school.

The participants in the present study come from diverse socio-economic backgrounds who are attending a public school in a disadvantaged area. Furthermore their socio-economic background determines whether they have access to the latest technological devices and also influences their levels of confidence with regard to using the latest technological gadgets.

Biott and Easen (1994) identified the imposed and emergent structures and stated that the imposed structure refers to the enforced or the formal structure and can at the same time be considered as teacher-directed whereas the emergent structure can be viewed as the informal child-initiated structure.

It is imperative that the aspects of collaboration and interactivity as mentioned by Dillenbourg (1999) be examined in terms of the impact the use of the IWB has on collaborative learning and interactivity among learners. Crucial aspects *imposed* and *emergent structure* as mentioned by Biott and Easen (1994) need to be investigated to see what impact these types of structures have on collaborative learning.

1.4 Research Site

The study portrayed in this dissertation was conducted at a disadvantaged, multilingual and multiracial school in the Western Cape. The school caters for Afrikaans, English, French and other indigenous African language speakers. The number of learners enrolled at the school is 1931 and the number of teachers is 54. The grades range from Grade R to Grade 7 and each class has more or less 46 learners. There is one computer teacher and learners from Grade 1 to Grade 7 participate in computer education for 35 minutes per week.

This is considered a disadvantaged school and it falls under section 21 of the South African Schools' Act of 1996. According to the section 21 regulation, schools can charge any amount as school fees (Roos 2009). In addition, the school fees at this particular school at the time of the investigation were R300 per year; the school has a Khanya laboratory and basic computer literacy classes are also offered to the community. Furthermore the teachers' computer literacy levels differ, and the teachers and learners raised funds to buy laptops that can be utilised in the classrooms. Currently eight Smart boards, six

e-Beams and several data projectors have also been also installed in most of the classes. This is a working-class community consisting mostly of single-parent units in addition the parents are not highly educated; most of them do not have secondary or tertiary qualifications.

This study was conducted as a case study and participants whom I interviewed were from a selected group of 43 Grade 6 learners who have basic computer and IWB skills. Those participating have access to computers and the internet as well as to the IWB at school.

1.5 Conceptual Framework

To understand the concept of 'collaboration' in IWB use, this study will draw on the work of Dillenbourg (1999). According to Dillenbourg a collaborative situation should be *interactive* and this is determined by the level of interactions amongst the peers. Secondly, collaborative interactions are always *negotiable*, meaning peers will argue their view, justify and attempt to convince (Dillenbourg 1999:13). Jewitt, Moss and Cardini (2007) noted the different types of interactivity that educators visualised when they used the IWB as tool to encourage 'interactivity'. I will be investigating how the IWB can be used as a tool to encourage 'physical interactivity' while learners are manipulating it.

Biott and Easen (1994) argued that certain collaborative activities will include different aspects of the context and may impart numerous features to which a person may respond. They have identified two pedagogical elements that impacted upon contextual features of collaboration which included the 'structure' and 'cultural response'. Two types of structures were mentioned, i.e. the 'imposed' and the 'emergent'. The 'imposed structure' refers to the obligatory or the official structure and can at the same time be regarded as teacher-directed, while the 'emergent structure' can be viewed as a child-initiated structure.

In their studies of IWBs Zevenbergen and Lerman (2008) and Kervin, Verenikina, Wrona and Jones (2010) both successfully used Activity Theory to understand the tensions between IWB, pedagogy and the curriculum. Murphy and Rodriques-Manzanares (2008) investigated how Activity Theory and its principles of contradictions may be relied on to guide research in education technology. They argued that a perspective on the contradictions can help understand how contradictions may result in educational innovation in a setting.

Activity theory is based on Vygotsky's work and includes both the mediating role of culture in all human encounters and also on the goal orientation of all activity (Engeström 1999). Leontiev's (1981 as cited in

Engeström 1999) expansion on activity theory highlighted the goal orientation and focused in particular on the various aspects: operations, actions and activity. In addition to the above, Engeström (1999) expanded upon the mediating tools and the participants and resources identified in the activity as well as their respective roles and responsibilities (Zevenbergen & Lerman 2008). The use of the IWB has the potential to encourage new forms of learning, but with new forms of learning comes change. Activity theory is ideal for the investigation of IWB use within a school situation because it is able to explain the tensions and difficulties within the change process (Zevenbergen & Lerman 2008).

Like Sweeney (2010), Zevenbergen and Lerman (2008) and Kervin et al. (2010), I will use Activity Theory to explain the *change process* which will allow a way of theorising the difficulties and tensions within the transformation process.

1.6 Research questions

The primary research question that guided my study is:

How do I need to adjust my pedagogy to optimise and support collaborative learning specifically interactivity and negotiability in lessons using an interactive whiteboard in a primary school?

In order to address the above question I will be using the field notes of my journal and the observation notes gathered from the two observers.

The subsidiary questions include:

- To what extent does the use of the IWB encourage negotiability amongst learners?
  Data from the journal, observer notes, learner questionnaires as well as the focus group questionnaires will be used to address this question.
- To what extent does the use of the IWB encourage interactivity amongst learners?

  Information describing how physical interactivity is visible while learners are using the IWB will be gathered from data gathered by the journal notes, observers' notes, the learner questionnaires and the focus group interviews.
- To what extent does an imposed or emergent structure impact upon collaboration when using the IWB?
  Information from the journal, observer notes, learner questionnaires as well as the focus group questionnaires will be used to address this question.

This study requires a framework that will allow for the analysis of collaborative learning specifically focusing on interactivity and negotiability in lessons using the IWB and the purpose of the IWB in the procedure, therefore I have chosen Activity Theory to provide a theoretical lens to help me explain the practices in the use of IWBs in the classroom. The data collected by means of journal notes, observations, learner questionnaires and focus group interviews will be analysed using the AT framework to gain insight in what is happening in class when a tool, the IWB, is in introduced and Action Research is used to review the process and in turn to improve on the pedagogy.

1.7 Methodological approach

For my investigation, I will be employing Action Research based on Zuber-Skerrit's (1992) model to examine how the IWB can be used to encourage collaboration amongst learners. The research methods for the present qualitative study will include questionnaires, focus group interviews, classroom observations and journal writing.

1.8 Thesis layout

The study is structured as follows:

Chapter 1

The introduction provides an overview of the background to the research; it also provides the rationale behind the study. Information pertaining to research sites follows and thereafter the conceptual and theoretical framework. The research questions follow and thereafter the methodological approach.

Chapter 2

Literature applicable to the foci of the study is reviewed. Empirical studies on IWB use in schooling and the theoretical and methodological approaches of research on how the IWB can encourage collaboration in a primary school are reviewed.

Chapter 3

The research design is outlined in this chapter and identifies the research orientation and qualitative methodology, namely Zuber-Skerrit's (1992) Action Research Model. A detailed description of the site and participant selection is given in this section. The methods of data collection include: journal writing, class observations and focus group interviews.

Chapter 4

This chapter focuses on the analysis and findings. An introduction outlines how Zuber-Skerrit's (1992) Action Research Model is implemented.

Chapter 5

This chapter identifies the different constraints, i.e. *Rules Community-Object*, *Tool-Object , Division of Labour-Community, Division of Labour-Subject*, *Subject-Tools-Object* and Activity Theory is used as a lens to scrutinise these contradictions. Resolutions are sought to resolve these constraints.

Chapter 6

This chapter summarises the study, also outlines lessons learnt, and highlights issues that need to be addressed, makes recommendations and suggests areas for further research.

Chapter 2: Literature Review

2.1 Introduction

As this action research study seeks to explore ways in which pedagogy needs to be adapted to make optimum use of interactive whiteboards in primary schools, this chapter reviews the literature that my study draws upon conceptually by research undertaken by Dillenbourg (1999), Biott and Easen (1994), Zevenbergen and Lerman (2008), Thornley (2010) and Sweeney (2010). Their investigations focused on using the interactive whiteboard as a tool in education and its role in supporting teaching and learning in general and collaborative learning in particular. The core concepts of *physical interactivity* (Jewitt et al.2007*)* and *negotiability* (Dillenbourg 1999), within a collaborative setting as well as understanding *emergent* and *imposed* structures (Biott & Easen 1994), and their impact on collaborative learning will be discussed.

The theoretical framework of my study draws on Engeström's (2000) Third-Generation Activity Theory and will be related to empirical research undertaken by Zevenbergen and Lerman (2008), Thornley (2010) and Sweeney (2010). I employ a modified version of Zuber-Skerrit's (1992) Action Research model to guide my methodology and uncover the information for this study.

2.2 Interactive Whiteboards in schools

From the beginning of the 21 century, IWBs have been increasingly deployed in schools in developed countries and gradually in developing countries. In the developed countries, such as the United Kingdom, the government has invested billions to implement the IWB in classrooms to enhance teaching and learning (Zevenbergen & Lerman 2008). In the South African context, Slay et al. (2007) conducted a feasibility study in the Eastern Cape to determine the potential benefits and drawbacks of (IWB use in schools in Eastern Cape before they were deployed, while the Khanya Project rolled-out IWBs in the Western Cape).

Zevenbergen and Lerman (2008), Thornley (2010), Sweeney (2010) and Levy (2002) claimed that IWBs can enhance collaborative learning in the education domain. This has given rise to my quest to seek and understand and investigate how the IWB as a tool can be used to support collaborative learning specifically focusing on negotiability and interactivity.

2.3 IWB affordances

Thornley (2010:21) listed the following IWB functionalities:

- Access to any software or resources that are available on the attached computer
- The opportunity to capture notes or images written on the whiteboard electronically
- Clicking and dragging of objects, images and text; annotating or marking up a presentation
- Translating written notes into text (on some IWBs)
- A multitude of useful teaching tools such as hide, reveal, magnify, sound and video.

Cuthell (2005) noted the following affordances of the IWB: The IWB could be used to do PowerPoint presentations in order to deliver and transfer knowledge as well as the creation of written materials, diagrams, clips from the Internet and pictures which could be displayed on the board and highlighted (Cuthell 2005).

Becta (2003) reported the following on the affordances of the IWB: using web-based resources in whole class teaching as well as showing video clips to help explain concepts. Furthermore they noted the demonstration of software, creating digital flipcharts, manipulating text and practicing handwriting. In addition they also mentioned that students can present their work on the IWB (Becta 2003).

2.4 Collaborative learning

According to Dillenbourg (1999:1) the notion of 'collaborative learning' can be defined generally as "as a situation in which two or more people learn or attempt to learn something together". This implies that two or more people or a class studying material formally or informally by way of interaction that can include a face-to-face meeting (Dillenbourg, 1999:1). Dillenbourg (1999) stipulated a four-point process to encourage interaction among learners. A set-up for collaboration must first of all be designed carefully (although this in itself cannot guarantee interaction). Thereafter various roles must be assigned to all the members of the group before rules are laid down as to how turns will be taken. It must lastly also be clarified how interactions are to be regulated and monitored by the teacher. Dillenbourg's (1999) methodology was incorporated into this study to encourage collaboration among the learners supported by the use of the IWB.

Rochelle (1992:42) defined collaboration more specifically as the "mutual construction of knowledge where two (or more) people construct shared meanings for conversations, concepts and experiences." Golub (1988) noted that collaborative learning has a core feature in place, which permits students to talk. According to Golub (1988) students are 'supposed' to converse with each other as they work

together on classroom activities because it is in the talking that learning takes place. He stressed that collaborative learning allows students to learn by "talking it out" Golub (1988:1). By "talking it out" students are incorporating their ideas and information through interaction with others. According to Golub (1988) the role of the teacher changes from 'information giver' to that of 'guide on the side'. The "teacher as facilitator is available to respond to the students' emerging insights" (Golub 1988:1). For this purpose of this study collaborative learning will be defined as two or more persons working together, sharing ideas towards reaching a goal.

2.4.1 Relations between collaborative learning and IWB use

Warwick and Kershner noted the following factors that influenced learning when encouraging collaborative work at the IWB:

> "the importance of sharing and applying knowledge; the necessity of information processing and metacognition; the importance of mediation, particularly by the teacher; the role of motivation" (2008:278).

Warwick, Mercer, Kershner and Staarman (2010:358) reported that the IWB can provide both a tool and a setting that "might be a key that is used to help create and unlock the potential of a dialogic space for pupil group work at the IWB."

Warwick et al. (2010) agreed with Yoon, Ho and Hedberg (2005) that the manner in which technology, the learning activity and the teacher support fuse together leads to the development and engaging learning experiences. Warwick et al. (2010) reported that the proficient maneuvering by the teacher of the parameters for learner communication in groups as well as the ICT used help to construct and unravel the possibility of a space for learner negotiation whilst using the IWB.

They have noted that specific affordances of the IWB are drawn upon by the teachers in mediating their created IWB environments for pupil knowledge acquisition in science (Warwick et al., 2010). Consequently, to draw out certain intentions behind the use of these affordances, it is useful to indicate their relationships with the scaffolding classifications that are applied to teaching methods in traditional lessons (Warwick et al., 2010).

2.4.2 Interactivity

Dillenbourg described collaboration as "a situation in which learners interact in a collaborative way" (1999:8). Furthermore he explained that the extent of 'interactivity' amongst peers do not refer to the

frequency of interactions, but by the extent to which these interactions influence the peers' cognitive processes" (Dillenbourg 1999:8).

2.4.2.1 Relations between Interactivity and IWB use

In investigating the use of the IWB in mathematics classrooms, Jones and Tanner (2002 as cited in Zevenbergen & Lerman 2007) noted that interactivity can be encouraged through quality questioning where the quality of the questions presented and the breadth of questioning need to be designed to guarantee interactivity. Jewitt et al. (2007) noted the different types of interactivity that educators envisage when the use the IWB as tool to encourage interactivity. According to Jewitt et al. (2007) the type of text design determines the kind of interactivity elicited by the use of the technology. The following types of interactivity were identified by Jewitt et al. (2007):

- Technical interactivity, which refers to interacting with technological facilities of the IWB.
- Physical interactivity, which refers to going up to the front and manipulating elements on the IWB.
- Conceptual interactivity, which refers to the focus on interacting with, exploring and constructing curriculum concepts and ideas.

Since it was not easy to distinguish between Jewitt et al.'s (2007) "*technical interactivity and physical interactivity,* I have decided to combine the concepts and used the term *physical interactivity.* In this study, the concept ***technical** interactivity* can therefore be understood as being synonymous with *physical interactivity.*

Higgins, Beauchamp and Miller (2007) noted that technical interactivity may result in more teacher interaction with technology. Higgins et al. (2007:219) argued that there is a significant divergence between technical interactivity afforded by the IWB and the pedagogical interactivity afforded by the mediating properties of the IWB. Technical interactivity refers to the enhanced facility for teacher or pupils to work with a range of digital materials and manipulate them on the touch-sensitive screen, whereas pedagogical interactivity refers to more effective interaction between teacher and learner or learners and learners that enhances the intended learning (Higgins et al., 2007). It needs to be kept in mind that technical interactivity does not necessarily transfer into pedagogical interactivity (Higgins et al., 2007).

Kervin et al. (2010) argued that the implementation of interactive technology in the educational domain will not necessarily lead to deep and interactive student learning. Their study also revealed that the rules embedded in technology do not always correlate with highly interactive learning practices hence

although the IWB was by definition interactive, the interactivity did not encourage the features of interactive learning (Kervin et al., 2010).

Kennewell, Tanner, Jones and Beauchamp (2008) argued that the level of interactivity generated by the IWB depends on manner in which the IWB is used and the teacher's ability to devise the affordances and deal with the constraints of the context. My investigation strives to use the IWB to encourage "*physical interactivity*" amongst the learners.

2.4.3 Negotiability

Dillenbourg (1999) mentioned another feature of collaboration, namely 'negotiability'. He stressed that "negotiability" implied that a learner will not force his opinion on the rest of the group, but will validate his claim by trying to convince the rest of the group. Jewitt et al. (2007) have also identified *conceptual interactivity* where the emphasis is on interacting and exploring. In this study the concept of *conceptual interactivity* can be understood as being synonymous with the concept of negotiability.

2.4.4 Group structures in the classroom

Biott and Easen (1994) noted that collaborative learning is about the development of the self in a social context, which therefore means that collaborative learning has both personal and contextual features. Personal features of collaboration include "goals of the collaborative activity" these refer to the performance of members within the group and understanding something new. The "nature of the collaborative activity" is the other personal feature and indicates whether the activity is challenging or easy (Biott & Easen 1994). Contextual features of collaborative learning refer to the structure through which collaboration is created and these structures are: the 'emergent' and the 'imposed' structure (Biott & Easen 1994).

Since the type of structure influences the context of collaboration (Biott & Easen 1994), I will be examining to what extent the 'emergent' and 'imposed' structure impact upon the collaborative process while learners are using the IWB as a tool to encourage physical interactivity and negotiability. Children are exposed to and expected to belong to two different interlocking social structures: the structure of the child culture and structures created by the teacher (Biott & Easen 1994). To participate in the classroom learning community, children are required to cope with the role expectations of learners by their teachers and to consider their personal interest with regard to choices of friends (Biott & Easen 1994).

Biott and Easen (1994) cautioned that researchers should be careful when making judgments about children's participation in groups from impressions gained as an observations as the researcher can be misled into making superficial interpretations of what is actually happening and could miss crucial factors of participation and learning. They also mentioned that teachers should try to construct favourable environments by modeling and placing high value on collaboration (Biott & Easen 1994).

2.4.4.1 Emergent structures

The 'emergent' structure refers to the child-initiated structure and can be seen in the various friendship groups that children form (Biott & Easen 1994). The core theme of the emergent structure is friendship, a form of relationship that encourages a "feeling of belonging and a sense of identity" (Biott & Easen 1994:37). Social aptitude is acquired through being with friends and being able to act on shared understanding such as when and how to make a claim as well as to react, contribute to and work as a group (Biott & Easen 1994).

2.4.4.2 Imposed structures

On the contrary, the "imposed" structure refers to the teacher-directed structure and this can be illustrated by viewing the official classroom setting where the teacher instructs learners to work in specific groups (Biott & Easen 1994). When the imposed structure is in operation, children are allocated to groups by the teacher and they are given tasks and expected to work as a team. These 'imposed' structures may be groups with match or mix capabilities (i.e. groups with the same or a variety of abilities), single- or mixed-gender or race groups, and may not be compatible to existing friendship patterns (Biott & Easen 1994). Biott and Easen (1994:43) argued that we should not expect that "participation in group work will be straightforward and focused entirely on the task" in the 'imposed' structure.

2.4.5 Relations between negotiability and IWB use

According to Mercer, Warwick, Kershner and Staarman (2010) the IWB offers the following useful affordances to support discussion amongst learners: Firstly they mentioned that the IWB allows learners to retrieve arranged materials which the teacher has prepared beforehand. Then they also mentioned that learners can annotate materials (add footnotes or comments) to indicate the progression in the discussion. In addition the affordances also allow learners to remove or modify what they have written-giving learners the option of changing their ideas. Furthermore they mentioned that the 'big screen' ensures that everyone can see what is written on (discussed) on the IWB as well as what each one has contributed as annotations to the materials. They also mentioned that the affordances allowed learners

to offer advice to each other about their annotations or other treatment of material" (Mercer et al., 2010:381-382). Mercer et al. (2010) examined how the use of the IWB supported and contextualize forms of valuable conversation and other forms of communication in collaborative science activities in the primary classroom. Warwick et al. (2010) also noted that the teacher is not absent from the learning process, but merely acts as a guide in the collaborative learning process. As a result, teacher involvement is necessary and the change of pedagogy to optimise the affordances of IWB use is essential.

Hennessy, Deany, Ruthven and Winterbottom (2007) noted that the IWB affords substantial agency to learners to outline their own patterns of participation in classroom situations. In addition they noted that the IWB releases the teacher from the front and increases pupil agency allowing for more opportunities for learners to participate in classroom activities by presenting and explaining their own materials (Hennessy et al., 2007).

Warwick and Kershner (2008) noted that children's collaborative learning may require explicit teacher involvement and supervision at particular phases in the learning. In addition they also noted that the IWB "added value" when it is used to enhance collaborative work (Warwick & Kershner 2008).

Teachers claimed that the resources available on the IWB offered them ways to change or adapt their pedagogy and mentioned that other aspects of work was influenced (for example a math teacher was teaching 'area' and found lessons on the IWB on area that were already prepared which he could adapt to suit his learners' needs) (Zevenbergen & Lerman 2008).

2.5 Theoretical underpinnings of related studies

Murphy and Rodriquez-Manzanares (2008) analysed the use of Activity Theory in relation to enquiring about educational technology in general, while Zevenbergen and Lerman (2008) and Sweeney (2010) and Kervin et al. (2010)) investigated how Activity Theory can be used to describe how the implementation of the IWB in education causes tensions within the activity system.

Zevenbergen and Lerman (2008) investigated the use of the IWB in a Mathematics classroom at a primary school in Australia. They drew on the principles of Activity Theory to frame the investigation and reflect on the various tensions encountered while using the IWB to support learning in the classroom. Zevenbergen and Lerman (2008) viewed the IWB as artifact that structures the ways in which learning can take place.

They also noted that the built-in tools reduced the time spent on lesson preparation as well as within the lesson, therefore it also added to a quicker pacing of lessons (Zevenbergen & Lerman 2008). An observation during their study of a Mathematics session shows how the accuracy of the IWB makes teaching of fractions with the fraction creator possible in new and creative ways. They mentioned the accuracy of the sections of the fractions which made for less confusion as to size and also to indicate difficult representations of the fractions (Zevenbergen & Lerman 2008).

Although the IWB has the potential to enhance the learning process and change the mathematical pedagogy for the teacher, the transformation will always be mediated by other experiences because on its own the IWB will not be able to transform pedagogy (Zevenbergen & Lerman 2008).

The most significant tension that surfaced in their investigation was between the roles of the teacher and the student as in 'contemporary teaching practices' where student-centred activity work occurs, but with the implementation of the IWB they experienced a shift to teacher-directed activities where the students remained passive (Zevenbergen & Lerman 2008:122). Even though the IWB offers potential for higher degree of interactions between pupils and teachers, the need to be in control of the class hampers the pedagogic transfer towards greater intellectual challenge (Zevenbergen & Lerman 2008:122).

In Activity Theory, signs and tools mediate learning and in Zevenbergen and Lerman's (2008) investigation the IWB was regarded as the mediating artefact. Their research reveals that an extensive number of resources are readily available on the IWB's databank. Teachers' lesson preparation and teaching styles were influenced as a result of the accessible resources. The 'built-in toolkit' enabled the teachers to move much quicker through the lessons. Furthermore they also note the strength of the IWB in accurately representing the different fraction sizes. PowerPoint slides contributed to faster-paced lessons and greater control of the learners.

Division of labour is also an important aspect in Activity Theory. Zevenbergen and Lerman (2008) encountered the following in their investigation: Teachers were in control of the IWB use. Learners were seated and on the floor and invited to participate. Although the above traditional teaching approach tended to disengage learners in the learning process, the observation done by the authors showed that learners were disengaged in the lesson due to the minimal student interaction Zevenbergen and Lerman (2008).

Again this study is inspired by a quest to investigate how I need to adjust my pedagogy to optimise and support collaborative learning and specifically focusing on interactivity and negotiability in lessons using the IWB in a primary school. Therefore, it requires a framework that will permit the analysis of collaborative learning and the purpose of the IWB in the procedure. As the above discussion shows, Activity Theory provided a very useful theoretical lens to help me explain the practices in the use of IWBs in the classroom. I have therefore adopted the Activity Theory framework in this study.

Sweeney (2010) investigated the impact of IWBs on teachers' pedagogy in Australia and used Activity Theory as a lens to investigate the dialectical process by which teachers' consciousness and professional learning development are shaped by the infusion of IWBs in the educational domain. Her investigation centres distinctively on the educators' perceptions about the contradictions which they encountered in their practice related to advice from professional development activities (Sweeney 2010). Sweeney (2010:3) argued that resolutions of these contradictions are crucial "to support teachers to progress their pedagogical development using IWBs".

Teachers who participated in the investigation experienced a 'breakthrough' as they progressed from the incorporation stage along predictable patterns of development from managing the IWB to competently using it in their practice (Sweeny 2010:33).

Sweeny (2010:32) noted that 'teacher-centred' lessons posed a tension and a resolution to the tension was for the teacher to convert her pedagogy to a more student-centred approach allowing students to develop their skills in using the IWB. Sweeny (2010) concluded that IWBs have the ability to encourage to student learning, but the use of the IWB alone does not change education. She claimed that change is always mediated by other experiences and requires educators to progress pass the crucial 'breakthrough' developmental stage (Sweeney 2010).

Kervin et al. (2010) investigated ways in which a teacher uses the IWB to mediate the literacy learning experiences of learners in a primary classroom in Sydney, Australia. Activity Theory (AT) was used as a framework to gain insight into internal tensions that occur when a new tool is introduced in an existing activity system. The use of AT enabled them to uncover the prejudices and beliefs that the teachers brought to the classroom. According to Kervin et al. (2010) the teacher brought prejudices and beliefs to the literacy experience, which therefore influenced their outlook regarding the ability of technology to successfully mediate the literacy experience. They also noted that the teachers' pedagogical views affected how the tool will be used to mediate the literacy experience.

> "Thus, the division of labour was influenced by not only pragmatics such as time constrains, ownership of resource, and the rules that govern the technology, but also by the teacher's view about the value of technology as a vehicle to enhance learning" (Kervin et al., 2010:9).

An important aspect that Kervin et al. (2010) investigated was the 'rules' of the literacy Activity System. The 'rules' determine what can or cannot be done within an Activity System. "The rules embedded in technology do not always correlate with highly interactive learning practices" (Kervin et al., 2010:10). In this investigation the IWB software only allowed one person to manipulate the IWB at a time. They also noted even though "the technology was by definition interactive, the interactivity did not support the features of interactive learning" (Kervin et al., 2010:10). Furthermore, the rules that are embedded in the curriculum influence and determine how technology will mediate practice and which type of practices teachers may utilise (Kervin et al., 2010). Although the investigation by Kervin et al. (2010) shows that the IWB was regarded as an interactive device, the interactivity did not support the features of interactive learning.

2.6 Activity Theory

According to Daniels (2004:189):

> "Activity theorists seek to analyse the development of consciousness within practical social activity settings. Their emphasis is on the psychological impacts of organised activity and the social conditions and systems which are produced in and through such activity."

Daniels (2004) also noted that Engeström (1999) sees the combined activity or practice as the unit of analysis for activity theory, not individual activity. He argued that Engeström was interested in the process of social change and noted that the structure of the social world should be included in the analysis of the change process. Daniels (2004) mentioned that the conflictual nature of social practice must be taken into consideration during the analysis. According to Daniels (2004:189) Engeström viewed the internal contradictions as the "motive force for change and development" and the shift and restructuring within and between activity systems as part of the progression. He argued that it is not only the participants, but also the setting that is modified through mediated activity (Daniels 2004).

According to Vygotsky (1978 cited in Laister & Koubek 2001) socio-cultural theory of learning human intelligence is shaped in the society or culture, and furthermore individual cognitive growth occurs first through interpersonal interaction (i.e. interaction with social environment) and then intrapersonally (the individual level). Furthermore, Vygotsky depicts cognitive development as a continuous process of

discourse between the child and the society through which the child internalises social knowledge and norms and constructs his own knowledge (Vygotsky 1978 cited in Laister & Koubek 2001).

Vygotsky's two stages (i.e. interpersonal and intrapersonal) were observed in students' maturity. During the initial phase of problem solving, students scaffolded and guided each other; in the second phase students came to formulate their own assumptions. New tactics were gained through peer collaboration by interpersonal discourse (Vygotsky 1978 cited in Laister & Koubek 2001).

Vygotsky saw collaborative learning as crucial to any educational and cognitive process. Collaborative learning is crucial in shifting any learner from the Zone of Proximal Development (ZPD) "the distance between the [child's] actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky 1978:131 cited in Laister & Koubek 2001:3).

Laister and Koubek (2001) noted that Vygotsky introduced what is now called the first generation Activity Theory where the model included a subject, and the object of activity. According to the model, the subject cannot act directly on the object, but requires tool mediation to perform cognitive functions. Vygotsky's model of mediated action is depicted in (Figure 2.2 Outline of Activity Theory Framework

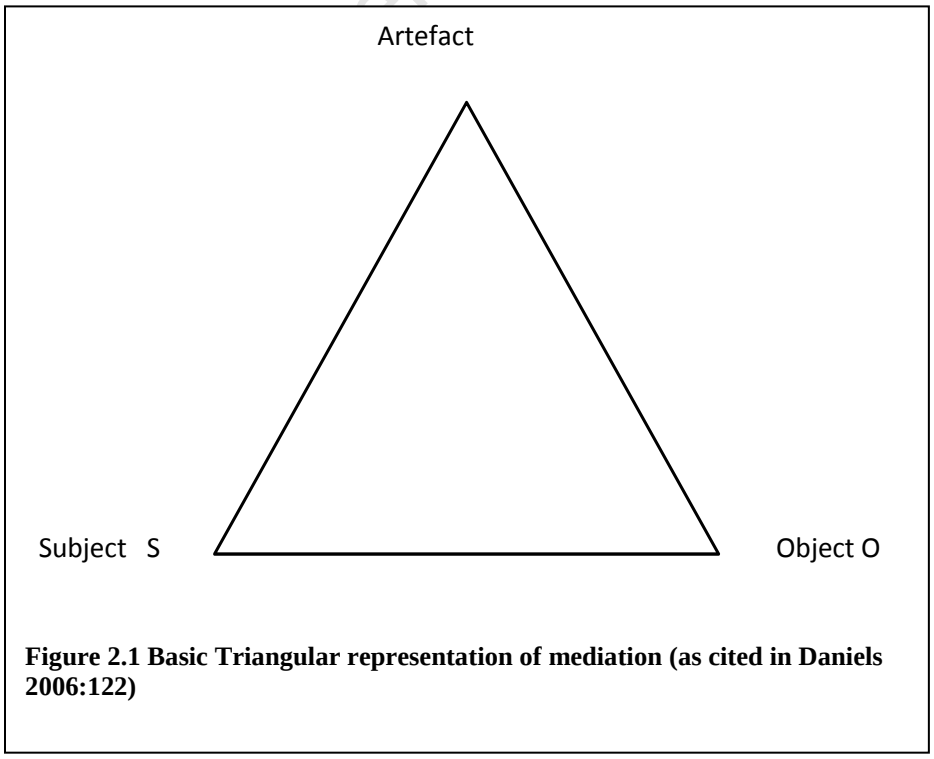


Figure 2.1 Basic Triangular representation of mediation (as cited in Daniels 2006:122)

According to Laister and Koubek (2001) Leontiev, one of the principal founders of Activity Theory, extended Vygotsky's framework and introduced what is now referred to as the second generation Activity Theory model, by highlighting the difference between activity, action and operation (three-level model of activity). Leontiev identified the crucial difference between an individual action and a collective activity (Laister & Koubek 2001). Laister & Koubek (2001) also noted that (according to Leontiev) the individual is simultaneously involved in two hierarchies of action. In the first instance, the individual pursues his/her own goal and in the group context he/she together with the other members strive to achieve the collective goal. In view of that, an individual's activity is not seen in isolation, but rather within the larger cultural context. The theory holds that any educational process that involves individual action should be viewed from the larger cultural context. It considers collaborative learning as contributing to the process of externalisation, which converts internal activities into external ones. Externalisation is crucial when any collaboration between several people requires their activities to be performed externally to be coordinated (Laister & Koubek 2001:3). Externalisation is important when any collaboration between several people requires their activities to be performed externally in order to be coordinated.

Engeström improved upon Leontiev's theory and introduced the third generation Activity Theory (Engeström 1999). He developed the following diagram(Figure 2.2) which depicts the core aspects of an activity

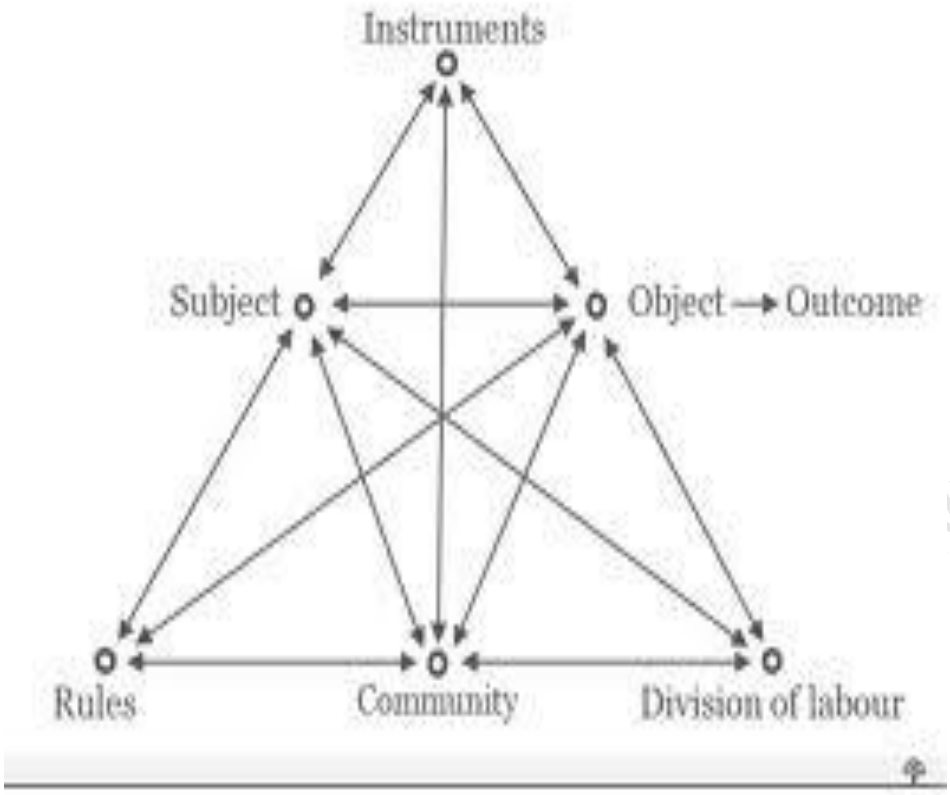


Figure 2.2 Outline of Activity Theory Framework

The concepts at the basis of Engeström's illustration, i.e. *community, rules and division of labour,* portray a conceptual framework that binds together local human activity and the larger social cultural-historical structures (Engeström 1999). In the centre of the diagram the *subject* and the goal-directed activity is depicted to be mediated by *tools* and artifacts (Engeström 1999). The *subject* in the third-generation activity theory model is an individual or subgroup whose activity is the prospect of the analysis (Engeström 1999).The object portrays the orientation of the activity. According to Engeström (1999) the '*object*' refers to the 'raw material' or problem space at which the activity is directed at and that change into outcomes with the help of physical and symbolic, external and internal tools, which mediate the activity. The '*object*' is the focus of the study and it signifies the total direction or shared purpose of the activity (Engeström 1999).

This investigation draws on Zevenbergen and Lerman (2008) and Sweeney's (2010) approaches of using Activity Theory to frame the analysis, particularly the concept of tools, in this instance the IWB, which mediate pedagogic relationships. In the Activity Theory framework, tools can refer to both physical and

semiotic tools. The values and beliefs that teachers embraced about pedagogy and /or technological devices mediated the manner in which they would use these technological devices.

The implementation of the IWB caused tensions in both Zevenbergen and Lerman's (2008) and Sweeney's (2010) investigations. Zevenbergen and Lerman (2007) noted the tensions were between the *artefact* and the *division of labour*. Drawbacks which they encountered were the breakdown in interaction between the teacher and their pupils. The lack of interaction could be ascribed to learners who were more focused on the IWBs and so paid less attention to the teachers. Zevenbergen and Lerman (2007) assumed that since educators tend to use the PowerPoint and pre-prepared lessons for the IWB they might become aware of pupils needs less frequently and diverting reaction to learners' needs.

Sweeney's (2010) highlighted the main tension in terms of *division of labour.* A resolution to this contradiction included a shift from *teacher-directed to learner-centred* approach. In my investigation the interacting components in the Activity System will be as follows: (Table2. 1)

Table2. 1Interacting Components of Activity Theory

The subject	Teacher
Tools	IWB, physical and semiotic tools
Division of labour	Learners, Teacher
Community	Learners
Rules	Collaboration, Group structure, Instructions
Object	Improve my pedagogy Using the IWB Technology Education to encourage negotiability and interactivity
Outcome	Teaching Technology concepts

Figure 2.2 Outline of Activity Theory Framework

Below in (Figure 2.2)is the outline of the Activity Theory framework that portrays how collaborative learning might take place whilst using the IWB. In this activity a *tool* (IWB) has been implemented at a primary school and the *subject* (teacher) is investigating (by means of an action research) how her pedagogy needs to be adjusted. The *object* of this activity is to use the IWB in the teaching and learning process to encourage negotiability and physical interactivity. The *outcomes* of this activity are lessons that elicit additional negotiability and physical interactivity. The *community* is represented by the learners whilst the '*rules'* refers to the group structures.

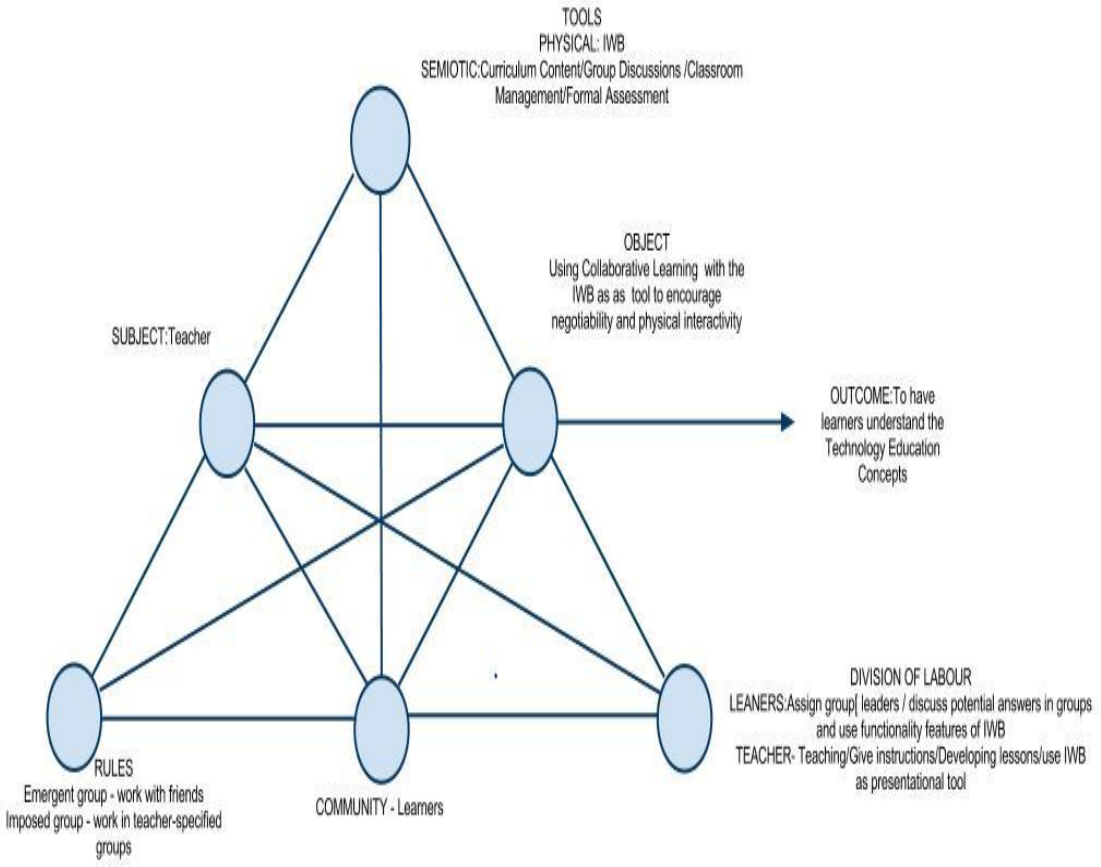


Figure 2.2 Outline of Activity Theory Framework

2.7 Summary of Chapter

This chapter outlined the conceptual and theoretical frameworks used for this investigation by discussing and defining the key concepts, including interactive whiteboards and their affordances; collaborative learning, specifically negotiability and interactivity; and group structures, specifically imposed and emergent structures and how all of these relate to IWBs. Activity Theory was identified and defended as a useful lens for understanding ways in which the use of the IWB in the classroom could encourage collaboration among learners and how a teacher would need to adapt her pedagogy to optimise the affordances of the IWB in the classroom.

In Chapter 3, I will describe the background of the research strategy and includes an explanation of the research methodology, the participants, the data collection, the data analysis techniques as well as ethical issues and validity adopted in this action research study.

Chapter 3: Research Design

3.1 Introduction

This chapter introduces the research design process of the investigation and covers the overall research orientation, the approach and methodology–specifically the site and participant selection, the data collection and analysis methods adopted, the research procedure and the ways in which validity and ethical issues have been addressed. This research study aims to investigate how the IWB can be used to encourage collaboration amongst the learners in a Grade 6 Technology Education class at a primary school in the Western Cape and specifically assist the teacher in understanding how her pedagogy needs to change to optimise learner collaboration in association with an interactive whiteboard.

The key research question is therefore: How do I need to adjust my pedagogy to optimise and support collaborative learning, specifically interactivity and negotiability, in lessons using an interactive whiteboard in a primary school? The purpose of my investigation is to provide a comprehensive report of how collaborative learning can be encouraged amongst learners while using the IWB and specifically how a teacher might need to change her pedagogy to optimise the affordances of the IWB. Data was collected through journal reflections, observations, questionnaires as well and focus group interviews.

3.2 Research Orientation

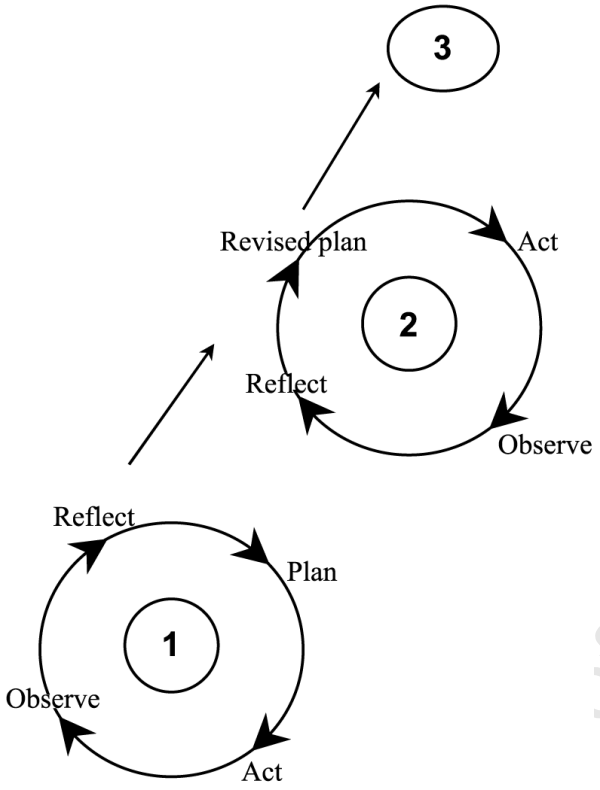
This study adopts an interpretivist orientation to research. According to Usher "the Interpretivist epistemology in social and educational research focuses on social practices" (1996:18). Usher (1996) also states that all human action is meaningful and should therefore be interpreted and understood within the context of social practices. This study is based on an interpretivist view of research as it focused on the observation of a real experience, the assessment of activities on the IWB, the evaluation of learners' opinions expressed in focus group interviews with a selection of learners who manipulated the IWB during collaborative lessons in Technology.

A qualitative approach enabled me, as the researcher, to be in direct contact with the subjects whom I observed while they were collaborating and using the IWB. Two observers and I observed the learners in the classroom while the investigation took place. I used various qualitative data collection and analysis methods to interpret the learners' actions.

3.3 Research Approach

The overall research approach adopted in this study is action research. Zuber-Skerrit (1992:7) states that “action research adopts a methodical, interactive approach embracing problem identification, action planning, evaluation and reflection”. The insights gained from the initial cycle feed into the second cycle, for which the action plan is modified and the research process repeated. According to Kemmis and McTaggart (1988:10 as cited in Hodgkinson & Maree 1998:52) "to do action research is to plan, act, observe and reflect more carefully, more systematically, and more rigorously than one usually does in everyday life; and to use the relationships between these moments in the process as a source of both improvement and knowledge". I have chosen to undertake an action research study due to the following reasons: At the school where I taught IWBs were installed, but many of the teachers including myself were not competent in using the IWB. This posed a problem because teachers were expected to use the tool in class without been given adequate training. In addition I also knew that implementing any tools in education would affect one's pedagogy and as a teacher I wanted to be prepared for the changes. Teaching is not just about the teacher imparting knowledge teaching is about involving the learners who participate in the process and empowering themselves. In order to prepare myself for the implementation of this technological phenomenon I wanted to see how the IWB would affect my current pedagogy and what changes I would need to bring about in my teaching methodology to successfully incorporate the IWB in my learning area, Technology Education. Most of the reported research focused on how the IWB was incorporated in the classrooms and on how the teacher would use the IWB. I decided to change my approach for the implementation and focus on getting learners to take the lead in their learning by giving them the reins and taking charge of manipulating the IWB. For this purpose, my current Technology Education materials had to be redeveloped in order to make them suitable for use on the IWB. I reviewed Zuber-Skerrit (1992) and Atkinson's (1992) Action Research models and decided to devise an Action Research model that would suit my investigation.

Zuber-Skerrit's (1992) Action Research Cycle, which consists of the four cycles, includes the phases Plan, Act, Observe and Reflect is portrayed below (Figure 3.1).



Source: Zuber-Skerritt (2001, p. 15)

Figure 3. 1 Zuber-Skerritt's (2002:15) Action Research Model

Atkinson's (1994) action research model consists of the following cycles: *Observation*, *Plan, Act and Reflect*. My investigation was based on Zuber-Skerrit's (1992) cyclical process because I deemed the *Planning* phase as crucial in preparation of the investigation. I modified my model slightly because in the execution of the different phases within the cycles, I have done things differently. I replaced 'action' with 'implementation' even though both words refer to the execution of the action research process. I replaced the word 'observation' with the word 'monitoring' as the word *monitoring* implies that a range of methods to monitor the action research study were used which include observation but are not limited to observation. Below is an outline of the comparison of the cyclical processes of the different action research models (Table 3.1 Comparison of cyclical process 1).

Table 3.1 Comparison of cyclical process 1 of different Action Research Models

	Atkinson's Action Research model	Zuber-Skerritt's Action Research model	My research model
1st Phase	Observe	Planning	Planning
2nd Phase	Plan	Action	Implementation
3rd Phase	Act	Observation	Monitoring
4th Phase	Reflect	Reflection	Reflection

- Planning

During this phase I strategised my plan of action for the intervention. I attended a basic IWB course in order to prepare me for the project. Furthermore I observed other teachers at my school who were competent in using the IWB in their classes. In addition I started developing IWB lessons for my interventions and identified teaching aids.

- Implementation

This phase occurred in the class and it entailed the teaching of the lessons, giving instructions, placing learners in different structures and allowing learners to do their activities at their tables or at the IWB. Learners were seated and negotiating or busy at the IWB while the observers watched them and write down what they saw learners were doing within the groups while they were busy engaging with each other. I started the lesson and gave an overview of the session.

- Monitoring

This phase entailed the observation of learners while they were busy in their groups negotiating and working on the IWB. The 2 observers also participated in the observations and documented how discussions unfolded in the groups as well as any other actions that occurred.

- Reflection

At the end of the intervention the reflection phase started where I reflected on the entire intervention and this normally occurred when I would be away from the investigation site. I looked at each aspect and analysed it for flaws. The reflection phase determined the improved measures to be put in place for the next intervention.

I arranged with the school to undertake the intervention as part of my action research study to investigate the incorporation of the IWB in my Technology Education class. The intervention was a planned effort to minimise the challenges that I would face when using a technological tool in the class and prepare myself to use the IWB optimally in my pedagogy.

The intervention consisted of three cycles and each cycle consisted of three lessons. Two different modules were taught during the interventions. During the intervention I introduced the new content to the learners. The introduction of the lesson was a face-to-face session using the PowerPoint presentation to enhance understanding and in some instances show learners examples of the actual item (for example the hydraulics-kit). Thereafter the learners were given an activity which they had to do and this was followed by instructions. While learners were occupied with the activity the two observers and I watched how they were interacting within the groups and wrote down our observations. After completion of the activity, learners were given the questionnaire to complete. The questionnaire as well as the Observer-schedules was collected .Thereafter I randomly chose one learner from each group to participate in the focus group interviews. The rest of the learners as well as the observers were allowed to leave the room for the interval which followed. The focus group interviews took place in the same room, followed by categorisation and coding of the collected data.

Below is an outline of the Cycle of learning actions (Table 3.2).

Table 3.2 Cycle of Learning Actions

Cycle of Learning Actions		
Learning Area: Technology Education		
1st Cycle	**2nd Cycle**	**3rd Cycle**
Module :SYSTEMS AND CONTROL	**Module: PROCESSING**	**Module: PROCESSING**
Planning	Planning	Planning
Implementation	Implementation	Implementation
Monitoring	Monitoring	Monitoring
Reflection	Reflection	Reflection

3.4 Research Methodology

3.4.1 Site selection

The site was chosen because I was teaching at the school while undertaking the investigation and because 12 IWBs were installed at the school at that time. I was curious to see what impact including an IWB in my lessons would have on my pedagogy. The study portrayed in this thesis was conducted at a

disadvantaged, multilingual and multiracial primary school in the Western Cape. Eighty percent of the learners at the school are English first language speakers whose home language is a mixture of English and Afrikaans and 20% are Afrikaans-speaking learners. The number of learners enrolled at the school during the investigation was 1785 and the number of teachers was 52. The grades ranges from Grade-R to Grade 7 and the teacher: learner ratio was 1:43.

3.4.2 Participant selection

Forty-one Grade 6-learners (all in the same class) of the primary school in the Western Cape were involved in the first round of the investigation. The forty-one learners were divided into eight groups of five to six learners when the class intervention started. The groups consisted of two boys and three girls and their ages ranged from 10 to 12 years. The second intervention consisted of a mixed group of learners (41 altogether) who were of learners from different grade 6 classes. The mixed classes occurred due to completion of the final year-end exams and learners being absent from school. After the first round of activities, eight learners, one from each group, were randomly chosen to participate in the focus group interviews. The focus group learners were advised about the confidentiality of their participation in the interviews and that no names would be mentioned in the study. They were also advised that they did not have to answer if they felt uncomfortable and would not be forced to participate in the interviews. The third intervention consisted of a new group of Grade 6 learners and there were 41 learners in this group. I requested the consent of all the learners' parents before the research study took place.

3.4.3 Methods of data collection

I used four research instruments which included a journal, class observations undertaken by me and two observers, a questionnaire for learners, and a focus group interview with one learner from each group.

3.4.3.1 Journaling

Hiemstra (2001) argued that journaling can be seen as a method of documenting personal thoughts, every day experiences and developing insights. Hiemstra (2001) also stated that journaling becomes an instrument to assist a person in terms of personal development or reflection on new information that is acquired. I kept a journal from the start of the proposal describing each experience I encountered in my attempt to explore how the use of the IWB might encourage collaboration amongst the Grade 6 learners in the Technology Education class and what pedagogical changes I made. The journal notes were used to address the research questions pertaining to the adjustment of my pedagogy and the encouragement of negotiability and physical interactivity by the learners.

3.4.3.2 Observations

The next step was to observe how collaborative learning could be supported by the IWB in the classroom. The observers in my investigation were non-participant observers (Cohen, Manion and Morrison 2007: 259). I chose teachers for the observer roles who were competent IWB-users and the purpose of their presence was to counter the issue of bias. Each observer was given an Observer Schedule to note their observations and I explained what aspects to look for with regard to *negotiability* and *physical interactivity.* They were also advised not to disturb the learner-participants while they were busy with their activities and in addition they had to collect evidence during the entire investigation by means of the following methods: they had to keep field notes of how learners were participating within the different structures (imposed and emergent). They also had to take photographs while learners were manipulating the IWB as well as the actual lesson on the IWB, they also had note how interactivity and negotiability occurs within the different settings. At the end of the sessions they had to hand in their observation sheets to me.

3.4.3.3 Questionnaire for learners

In my study I designed a questionnaire for the learners (Appendix 3.4) to determine how *negotiability* within a group and *physical interactivity* of the IWB was influenced by the different types of structures, i.e. "imposed and emergent". The purpose of the questionnaire was to get an indication about how learners were able to work in a group and also an indication that they were able to interact with one another.

After each intervention learners were given the questionnaire to complete. This questionnaire was used to determine whether learners worked well together in a group in the different structures. The purpose of the question was to determine the level of negotiability.The learners who participated in the investigation, were young and with English as their first language, therefore the questions had to be very simple and provide quite discrete options (

Table 3.3).

Table 3.3 Questionnaire – Question 1

How well did you work in your group?	**Quite well**	**Well**	**Not so well**

The following question was posed to determine whether participants could air their views freely within the groups they were working in so that it could be compared to the imposed and emergent groups they were working in. The purpose was to determine how *negotiability* takes place within the groups (Table 3.).

Table 3.4 Questionnaire – Question 2

Could you air your views within the group/say what you want to say freely?	**Yes**	**No**	**Sometimes**

Question 3 (Table 3.5) was used to determine whether participants enjoyed working as a group on the interactive whiteboard. The purpose of Question 3 was to determine how the IWB as a tool encouraged physical *interactivity* while the groups were working as a group (Table 3.).

Table 3.5 Questionnaire – Question 3

Did you enjoy working as a group on the interactive whiteboard?	**Yes**	**No**	**Sometimes**

3.4.3.4 Focus group

According to Richardson and Rabiee (2001), participants of a focus group are chosen due to their knowledge of the topic, or they are within the age-range, have similar socio-characteristics and would be comfortable conversing with their peers and the interviewer. A focus group consisting of 8 learners (one learner from each of the 8 groups), who were comfortable conversing with their peers as well as the researcher and were in the same age-range, were interviewed during the first, second and third intervention. The purpose of the focus group was to gather information of what was really happening in the groups ('insider information'). The interview was structured in such a manner in order to ascertain how the use of the IWB as instructional tool influenced their collaborative working within the group before they went to work on the IWB and while they were working on the IWB. The meeting with the focus group was held immediately after the interventions and in another classroom away from the rest of the class. The information gathered from the focus group was recorded on a cell phone. The recordings were transferred to a computer and stored on it as well and thereafter transcription was created (See Appendix 4.7).

3.4.4 Coding

The information from my journal entries, observation schedules, questionnaires and focus group interviews had to be coded in order to analyse the dominant theme. Maxwell and Miller (2008) offer a useful manner of analysing the huge amount of data. The most extensively used categorising strategy in

qualitative data analysis is coding (Maxwell & Miller 2008). Segments of information are labeled and grouped by category and the data are scrutinised from within and in between categories. Categorisation is a method of sorting the descriptive data that was collected (Maxwell & Miller2008). Meticulous recording of this process reveals how I worked from the initial qualitative data, down to a coded analysis.

During the coding process I noticed that several of the codes were being applied quite frequently. To counter the problem that I faced I developed smaller sub-code categories for the larger coding groups. In order to display how I applied the codes to the various segments of data from my observation data, I have selected an example for each sub-code as well as the larger code groups which were further broken down. Below is summary of these sub-codes as well as examples of the larger codes in (**Table 3.**6).

Table 3.6 Summary of the sub-codes for the larger groups

Large Code Groups	Code ID	Code
	OS	Observer Schedule
Example: FG Q2 L8 (Focus Group Questionnaire 2 Learner 8)	2	Second Intervention
	ES	Emergent Structure
Example :OS2 ES L2 OA LG2 (Observer Schedule no. 2 Emergent Structure Lesson 2 Observer A Learner Group 2	IS	Imposed Structure
	L2	Lesson 2
	OA	Observer A
	OB	Observer B
	LG	Learner group
	FG	Focus Question
	Q	Question
	L	Learner
	TR	Teacher Researcher

After I reviewed the qualitative data (for example transcripts, observation schedules) several times, a set of key themes emerged which were used to further understand the thematic issues which were raised and how these were linked to the research questions (Table 3.7)

Table 3.7 Examples of themes identified

Research Questions	**Concept**	**Theme**
To what extent does the use of the IWB encourage negotiability amongst learners	Negotiability	Group worked together well
		Active participation/ Input given
		Arguing
		Disruptive behaviour
To what extent does the use of the IWB encourage interactivity among learners?	Physical Interactivity	Able to use IWB/drag objects
		Difficulty in dragging objects

Table 3. 8 Examples of themes applied

Data Source	Instruction	Response	Negotiability					Interactivity				
			Positives				Negatives	Positives			Negatives	
	Describe what learners are doing within their groups. Indicate how learners are negotiating and manipulating (interacting with the IWB)		Group worked well together	Group formulated answer /consulted each other /collaborate/Worked towards finding an answer	Active participation/ / Input given	Lots of discussion/shared ideas /guided one another/ Assisted each other /conversing Lots of discussion/shared ideas /guided one another/ Assisted each other /conversing	Arguing	Disruptive behaviour	**Able to use IWB/Drag objects /**	**Assisted each other at the IWB**	**Difficulty in dragging objects**	**Struggled with answer at IWB**
OS2ISL1OALG1	Learners were involved in discussions.	Manipulation of the IWB. Learners taking turns to go to IWB.				1			1			

3.5 Research Procedure

3.5.1 Before the intervention

The following research procedure was undertaken to gather the necessary information: At the start of the study the staff and learners at the school were notified of the intended investigation. Letters were sent to the parents of the participants (See Appendix 3.3).and the Western Cape Education Department (See Appendix 3.1).

Thereafter I prepared myself for the intervention by attending a course to understand how to operate the IWB. I also observed classes at the site to see how teachers were using the IWB. Thereafter I started to developing materials suited for the IWB use.

3.5.2 During the intervention

Learners were made aware of the observers' presence and their purpose, questionnaires and the focus group interviews.

After introducing the first section of the lesson with a PowerPoint presentation, I divided the class in either the *imposed* or the *emergent* structured groups. The observers started to move around at that point to view how the learners were negotiating and thereafter the activity on the IWB followed.

The observers and I observed while learners were busy on the IWB. After the session on the IWB the learner questionnaires were distributed. Then eight learners were randomly chosen for the focus group interview and thereafter I collected the observer sheets.

3.5.3 After each intervention

The information would be grouped accordingly, analysed and coded. Then I counted the questionnaires and the observer sheets and checked whether the observers have recorded the data. I entered the collected data on the computer and saved it. More research and planning followed as I had to modify certain lessons in order to create more physical *interactivity and negotiability.*

The results of the first intervention would inform the way forward for the next intervention. The same procedure was followed at the end of the second intervention.

3.6 Validity and Ethical issues

3.6.1 Research Ethics

This research project adhered to the formal ethical protocols outlined in UCT's code of ethics. Prior to the start of data collection, I submitted a version of the research proposal as well as a letter requesting permission (See Appendix 3.1) to the Western Cape Education Department and the UCT Research Ethics Committee. I requested permission from the principal and staff of the school where the investigation would take place (See Appendix 3.2). Informed consent from each parent of the learners (See Appendix: 3 .4) participating in the research was also required. The identity of all 41 learners and observers has been kept confidential and no names are mentioned in the dissertation. I have agreed to make the findings of the investigation known to the staff of the school where the investigation took place.

3.6.2 Validity

Maxwell (2008) states that the qualitative researcher does not have the advantage of formal comparisons like the quantitative researcher who uses sampling strategies, or statistical manipulations that 'control' the outcome of particular variables. Qualitative researchers therefore need to rule out most validity threats after the research has begun, by using facts collected during the investigation itself to make these 'alternative hypotheses' incredible (Maxwell 2008). According to Maxwell (2008) this approach requires researchers to recognise the *specific* threat in question and to develop ways to attempt to rule out that actual threat.

To validate the investigation the following aspects had to be addressed: In order to launch this investigation I had to familiarise myself with how the IWB work and what type of activities were available on the Smart Board toolkit. To counter the threat that my lack of knowledge about using IWBs might undermine the validity of this research, I enrolled in a 4-week basic IWB course and observed other competent IWB teachers at work. I also needed to know how to develop suitable activities for the IWB that would elicit *negotiability* and physical *interactivity* amongst the learners. The activities had to be learner-centred and I used my existing activities which I developed before and converted those to suit the IWB use.

3.6.2.1 Triangulation

Guion et al. (2011) states that triangulation is required in qualitative research in order to validate the study. Validity will stipulate whether research findings accurately reflect the situation Guion et al. (2011). Triangulation in this instance refers to a variety of data collection methods being used to

increase the validity. Data collection that would verify that the IWB can be used as a tool to encourage *negotiability* and physical *interactivity* amongst Grade 6 learners included the triangulation of methods and sources.

Information from various individuals including myself (journal writing), the learners (their questionnaires and the focus group interviews) and the observations undertaken by observers was collected during the study to validate the findings of the investigation.

Data were gathered at the school where the investigation was launched. The collected data were stored in a hard copy (file) as well as in digital format. The persons who have access and can be contacted for data are the researcher and the supervisor who is supervising the investigation.

3.6.2.2 Bias

Maxwell (2008) stipulates that searching for discrepant evidence and negative logic and negative cases is crucial aspect of the logic of validity testing in qualitative research. To address the issue of bias, two observers who were competent IWB users were present during the study to observe the learners.

3.7 Summary of Chapter

This chapter focused on the research design, the participants of three groups of learners from a disadvantaged primary school in the Western Cape, data collection and data analysis. The chapter described how data was analysed and examined ways I have endeavoured to reduce the threats to validity of this study while maintaining the ethical practice throughout the investigation. The findings of the study that adopted various methods to collect data, namely the journal, class observations by the two observers, learner questionnaires and focus group interviews, will be discussed in Chapter 4.

Chapter 4: Analysis and Findings

4.1 Introduction

This chapter focused on the analysis and findings of the action research study. It concentrated on the three interventions that consisted of three lessons each. As was pointed out above, the key purpose of my action research study was to investigate how I needed to adjust my pedagogy in order to optimise collaboration, particularly negotiability as well as interactivity, in lessons using the interactive whiteboard. In this chapter the data collected were analysed and interpreted in an endeavour to understand how I could use the interactive whiteboard to encourage collaboration amongst Grade 6 learners in the Technology learning area. To reiterate, data were collected by means of observations, questionnaires, focus group interviews as well as my journal notes. Zuber-Skerrit stated that "the aim of action research was to bring about practical improvement, innovation, change or development of social practice and the practitioners' better understanding of their practices" (1992:171). In this instance the practical improvement was the adjustment of my pedagogy to maximise the collaboration amongst my learners. This adjustment included the adaptation of the materials for the IWB and the arrangement of group work according to imposed or emergent group structures.

I taught the lessons, with the assistance of the observers who observed the learners while they were negotiating the various tasks and manipulating the IWB. At the end of each lesson, I analysed the observer schedules as I wanted to see their views regarding their observations of the activities pertaining to my investigation of negotiability and interactivity amongst the learners. Their views assisted me with modifications to the lesson activities needed in order to elicit additional negotiability and interactivity amongst the learners. At the end of each cycle of lessons all the learners completed a questionnaire and eight participated in a focus group interview. After the first intervention the collected data from the first questionnaire, the first focus group interview and my journal notes of each day of the first three lessons were analysed. The findings gave me insights into how I had to modify the next intervention's lessons, and what information was lacking with regard to the observer schedules. Before the second lesson of the first intervention, I modified the observer schedules and had to explain to the observers that additional details were to be noted during the follow-up interventions and that they should not use the tally system only, as it provided insufficient information. The second intervention also followed the same procedure as the first. At the end of the analysis of the data of the second intervention modifications were made to the lessons where necessary. The changes required informed

the next cycle-the third intervention. After the third cycle the collected data were analysed and further recommendations noted for the change in my pedagogy.

Zuber-Skerrit's (1992) view of action research influenced my study in the following manner: I had to develop different strategies in order to change my pedagogy after the first intervention (cycle) before I could move to the second intervention (cycle) and thereafter the third. Zuber-Skerrit's (1992:130) cycle depicts the following steps: Plan, Act, Observe and Reflect. I have altered the naming of the different steps as explained in Chapter 3 in the following manner: Planning, Implementation, Monitoring and Reflection.

4.2 Analysis and findings

The following section consists of the analysis of the three interventions which consisted of three different lessons each and will be discussed according to the stages of the action research cycle.

4.3 First Intervention

The lessons in this intervention are based on the Systems and Control Module that focuses on the Mechanical, Hydraulics and Pneumatics aspects of Technology.

4.3.1 Lesson 1: Systems and Control: Mix and Match Activity

4.3.2 Planning

I took my developed materials that were aligned with the National Curriculum Statement and re-worked them so that they would be suited for the IWB. These activities were suitable for using basic stationery (i.e. pen and paper) to complete in the classroom without the IWB. In converting the developed materials, I had to look at the different ways of presenting lessons using the built-in toolkit of the IWB of the Smart Board resources and modify the materials so that the activities could elicit negotiability and physical interactivity amongst the learners. Lessons had to be devised in order to encourage the physical manipulation of the IWB. When using the IWB to replace pen and paper, I had to customise the lessons so that they could be loaded on the computer that has the Smart Board software installed. The first lesson was structured according to the Smart Board's Mix and Match facility so that learners could use the 'dragging' facility on the IWB and undertake the activity on the IWB (Figure 4.1).

I planned to divide the class of 41 learners in eight groups in order to investigate how the IWB as a tool could encourage negotiability and physical interactivity amongst the learners during the imposed and emergent structured group activities. I planned to introduce Lesson 1 using a PowerPoint presentation.

Thereafter, a brainstorming session would follow during which I planned to introduce a concept to the learners and ask them what idea comes to mind when they hear or see a particular word (for example 'investigate') and ask them if they can define the concept. Learners would also be given a hard copy of the actual activity so that I would not have to write the lesson on the board and the session could progress at a faster pace. To elicit negotiability I structured the lessons so that more in-depth discussion could be encouraged amongst the learners.

A fifteen minute session which would allow for observing of negotiability was planned and included the reading of the Mix and Match Activity (Figure 4.1) and discussion within the groups. Furthermore, I planned to use the imposed groups (selected by myself) and to examine how the learners worked together in these groups and how the group structure influenced negotiability amongst them while they were discussing and physically manipulating the IWB (Figure4.1).

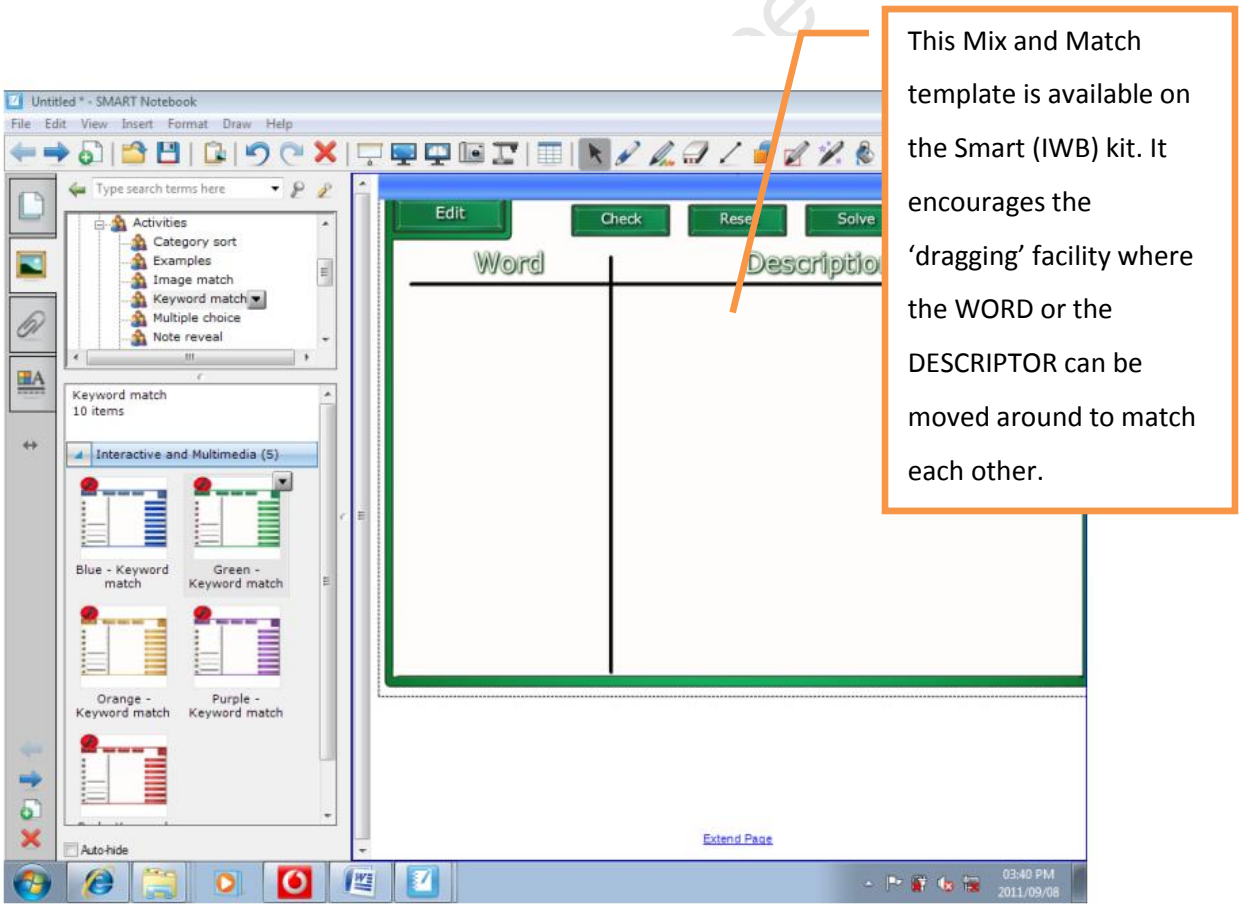


Figure4.1 Mix and Match Template on the IWB

4.3.3 Implementation

I divided the learners in groups thereby creating 'imposed groups'. Learners moved out of their seats and went to their assigned groups. There were eight groups of five to six learners each. I introduced the lesson by using a PowerPoint presentation (See Appendix 4.2). I facilitated the brainstorming process and it took about ten minutes to brainstorm the concepts which were linked to the PowerPoint Presentation. Learners had to link these words with the correct descriptor on the IWB activity. The instructions given to them encouraged them to discuss possible responses in their groups before going to the IWB to complete the activity. Observers moved around the class with monitoring sheets in hand. I gave a hard copy of the concepts to the learners (Table 4.1).

These concepts were explained to learners by means of a 'brainstorming' session

Table 4.1 Concepts

Investigate
Identify
Compare
Design aspects
Design brief
Input
Process
Output

Learners were given 15 minutes to organise themselves and read through the activity and discuss amongst themselves how they were going to engage with the activity. The learners assigned a group leader and started their discussions. Thereafter each group chose a word and decided which phrase was the best corresponding descriptor on the sheet (Table 4.2).

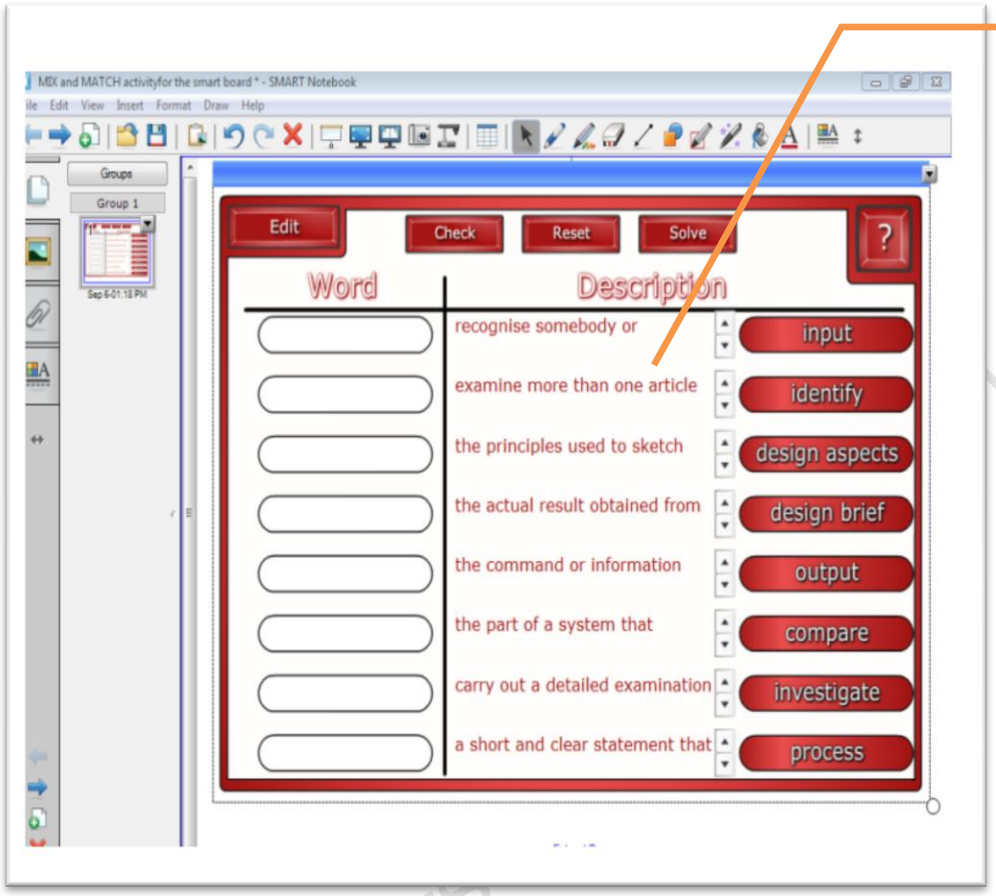
Examples of answers: Learners had to 'drag' the words and match them with the descriptors

Output	The actual result obtained from a system.
Identify	Recognise somebody or something and be able to say what he/she or it is.
Compare	Examine more than one article in order to discover similarities or differences.
Design brief	A short or clear statement that gives a general outline of problem to be solved as well as the proposed solution.
Design aspects	Principles used to sketch something.

Table 4.2 Mix and Match Activity Hard Copy

Word	Descriptor
Process	The actual result obtained from a system
Design Brief	Recognise someone or something and be able to say what he/she or it is
Input	Examine more than one article in order to discover similarities or differences
Investigation	A short clear statement that gives a general outline of problem to be solved as well as the proposed solution
Identify	Principles used to sketch something
Output	Carry a detailed examination or inquiry to find out about something
Compare	The part of a system that combines resources to produce an output in response to an input.
Design aspects	The command of information entered into a system

This is the Mix and Match activity on the IWB. Learners 'drag' the matching word to the description (Figure 4.2).



The following image portrays the completed Mix and Match activity on the Smart board activity toolkit

Figure 4.2 Mix and Match Activity on the IWB

4.3.4 Monitoring

4.3.4.1 Observer Schedules

Observer A observed 8 groups and noted 10 instances of negotiability in Groups 1, 3, 4, 6, 7 while Observer B noted 10 instances of negotiability in Groups 1, 2, 4, 5, 7. The "tally-type" approach did not provide sufficient detail for me to understand exactly what the observers were noting as "negotiability". As a researcher I needed to understand what the observers perceived as negotiability and what learners were actually doing while they were negotiating. The observers noted the learners' negotiability more than they noted the learners' physical interactivity with the IWB. Both Observer A and B noted far fewer instances of physical interactivity; only one occurrence in each of the eight groups (Table 4.3)

Table 4.3 Observer Schedule: Intervention 1 Lesson 1 Imposed Structure

	Negotiability		Physical Interactivity	
	Observer A	Observer B	Observer A	Observer B
Group 1	10	10	1	1
Group 2	7	10	1	1
Group 3	10	6	1	1
Group 4	10	10	1	1
Group 5	7	10	1	1
Group 6	10	7	1	1
Group 7	10	10	1	1
Group 8	10	10	1	1

4.3.4.2 Journal

My journal entries for Lesson 1 included only four comments. With respect to negotiability amongst the learners, I noted both positive and negative aspects, but with respect to physical interactivity I only noted negative features. Although the learners were all participating and conversing, sometimes displaying useful disagreement, some learners were reluctant to participate. I noted that the physical interactivity with the IWB was limited and that there was unnecessary, off-task talking (Table.4.4).

Table 4.4 Journal entries for Intervention 1, Lesson 1

Comment	Negotiability			Physical Interactivity	
	Positive		Negative	Negative	
	Participation	Disagreement	Reluctance to participate	Limited physical interactivity	Unnecessary talking
All learners were participating in the groups.(at first they were a bit reluctant, due to the imposed structure	✓		✓		
Negotiability is taking place. Learners were conversing with each other. A bit of arguing noticeable within certain groups	✓	✓			
NB. Limited interactivity. I have to review the lesson structure				✓	
Unnecessary talking among some groups					✓

4.3.5 Reflection

Reflecting on the observers' schedules and my journal entries, it is clear that the design of the Mix and Match lesson limited the physical interactivity as only one learner per group could go up to the board and drag the correct answer to match the descriptor. Negotiability was evident as learners were debating with each other and making sense of the concepts and deliberating which description best fitted with each word. With regard to changing my pedagogy I noted that I needed to develop lessons that would encourage more physical interactivity that would enable more than one learner to go to the IWB and manipulate it. According to the overall observations it appeared that during the imposed structure learners tended to be reluctant to participate in discussions. Due to this outcome, I decided to investigate what impact the emergent group structure might have on negotiability and physical interactivity when I included an IWB in a lesson.

4.3.6 Lesson 2 Systems and Control: Unjumbling Sentences

4.3.7 Planning

After the Mix and Match Activity, I decided to use a different method to elicit more negotiability and physical interactivity amongst the learners while using the IWB. The Unjumbling principle appealed to me because the 'Unjumbling' aspect encourages more interaction amongst learners and allows for more learners to physically interact with the IWB. I planned that learners would rearrange the words in the sentences and place them in the correct order so that the sentence structure would be grammatically correct. The structure of this session changed to the emergent group structure where learners could choose where they wanted to sit. I wanted to examine how group work using the emergent structure encourages negotiability and physical interactivity amongst learners while they were using the IWB as a tool in the Technology learning area.

4.3.8 Implementation

The introduction of the lesson started with a PowerPoint presentation (See Appendix 4.1) to explain the different types of mechanical systems within the Systems and Control Module (for example pneumatic and hydraulic) as well as the types of movement (for example rotary, reciprocating) and was followed by an animated PowerPoint Presentation with examples of how hydraulic and pneumatic systems work (See Appendix 4.2).

A hands-on activity session followed where I used a Hydraulics and Pneumatics kit (Figure 4.3) to demonstrate how the Hydraulics and Pneumatics mechanism works. The kit consists of two syringes and a piece of tubing that connects the syringes (Figure 4.3).

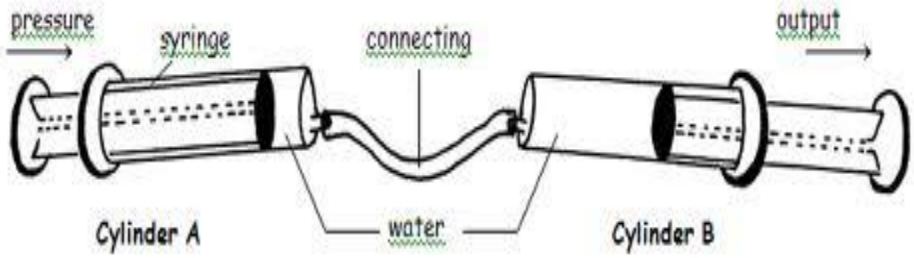


Figure 4.3 Pneumatics Hydraulics Kit

Thereafter learners were given a hard copy of the activity and as a group they had to construct the sentence in its correct form before they could make alterations on the muddled examples on the IWB (Table 4.5).

Table 4.5 Hard copy of muddled sentences

Group 1 Wedges systems Mechanical levers by such screws etc. Mechanism as using operates
Group 2 by systems air using operates Pneumatic
Group 3 systems a Hydraulic that system liquid operate compressed using by
Group 4 are Mechanisms or of part that machine a machines a performs task specific
Group 5 motion a line movement that something allows a straight move to in one Linear is
Group 6 and a Oscillating to fro movement motion
Group 7 allows movement Rotary something to move in a circle
Group 8 forwards straight in motion line and backwards a movement a Reciprocating

Then the learners went to the IWB and undertook the Unjumbling activity on the IWB. The learners dragged the words and placed them in the correct order. The Unjumbling activity below is an example of learners' work that was completed by them on the IWB (Figure 4.4).

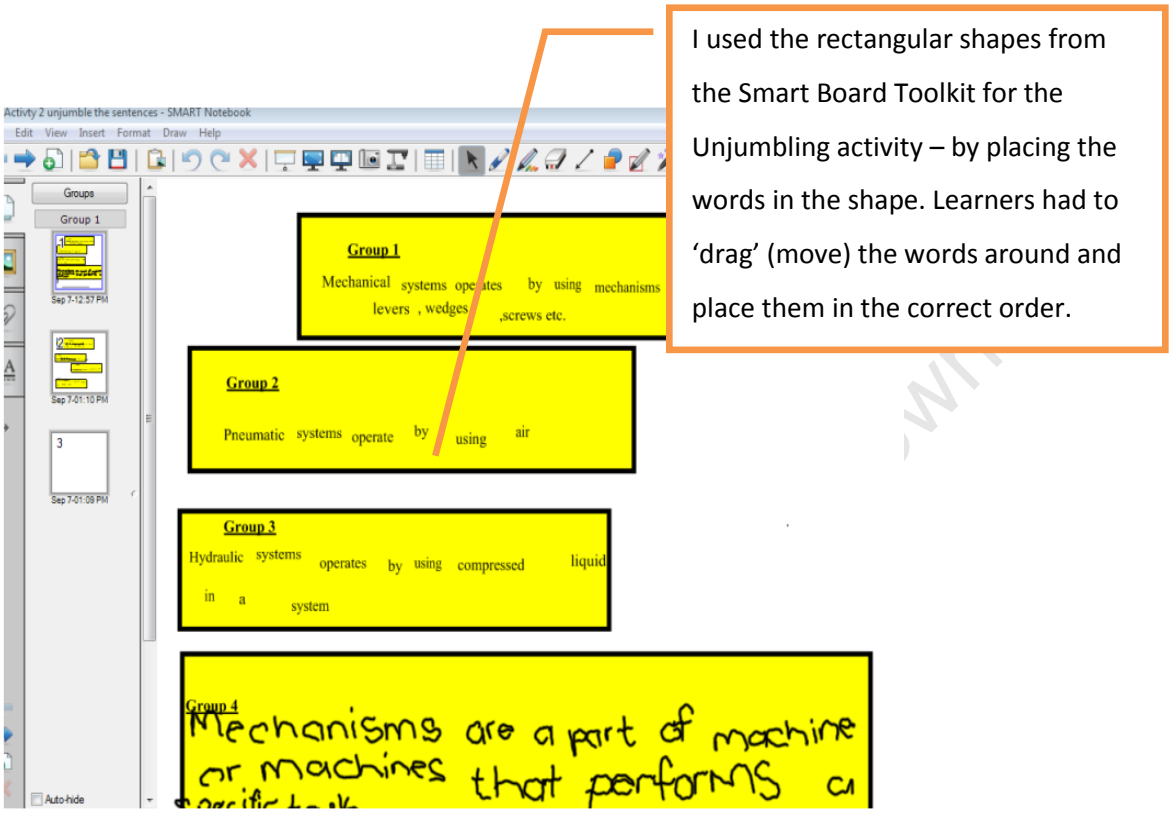


Figure 4.4 Unjumbling sentences on the IWB

4.3.9 Monitoring

4.3.9.1 Observer Schedules

The Observer Schedules (Table 4.6) highlighted the positive aspects of negotiability and physical interactivity. The observations revealed that negotiability occurs more in the emergent group structure. Physical interactivity, on the other hand, is more dependent on the type of activity that uses specific features of the IWB

Table 4 6 Observer Schedule Intervention 1 Lesson 1 Emergent Structure

Observer			Negotiability				Physical Interactivity	
			Positive		Negative		Positive	Negative
		Comment	Discussion / Conversing / Engagement	Group work well together /Assisting / Co operating Agree about work / Co ordination / Organisational skills	Arguing /Disagreement about task	Reluctance to participate	Learners are dragging items on the IWB /Manipulation of the IWB.	
A	Group 1	Discussion taking place	✓					
B		Good coordination between learners. Learner work on the IWB one at a time		✓			✓	
A	Group 2	Learners were discussing work.	✓					
B		Good group work. Learners work on the IWB		✓			✓	
A	Group 3	Discussion took place before learners went to the IWB. Learners solved problem by adding extra word.	✓	✓				
B		Learners take turns. They work well as group. Learners manipulate the IWB		✓			✓	
A	Group 4	Discussion taking place. Learner struggled with dragging the word on the IWB and switch to using pen	✓				✓	✓
B		Learners are much focused. Good working relationship amongst them. Learners working on the board	✓	✓			✓	
A	Group 5	Learners are discussing task and helping each other	✓	✓				
B		Learners marked off the words. Some disagree how things are done	✓		✓			
A	Group 6	Learners are discussing task and helping each other	✓	✓				
B		Learners display good organisational skills. A learner is busy on the IWB		✓			✓	
A	Group 7	Learner engagement evident at table and also when they do the work on the IWB	✓				✓	
B		Learners tick off the words and arrange in structure. Learners can drag items on the IWB		✓			✓	
A	Group 8	Group arguing at first about the way things should be done	✓		✓			
B		Learners are co-operating with each other and assisting one another. One learner is busy at the board at a time		✓			✓	

4.3.9.2 Journal

My journal notes revealed positive aspects with regard to the negotiability aspect and no negatives were noted. Negotiability amongst the groups was very intense, suggesting that when learners are working with their friends they are likely to discuss the task more easily. Learners seemed more relaxed in the emergent group structure, but also tended to talk more. Some of them were talking and giggling after they had reached a decision about the task. With respect to physical interactivity the only positive feature that was evident was that the Unjumbling structure of the lesson allowed more learners to go to the IWB and manipulate it (See Appendix 4.3). This shows that the entire group went to the IWB and assisted one another with the 'Unjumbling' of the sentences (Table 4.7)

Table 4 7Journal entries of Intervention 1 Lesson 2

Comment	Negotiability				Physical Interactivity	
	Positive			Negative	Positive	Negatives
	Participation	Disagreement	Assistance rendered to slow learners		More interactivity	
Negotiability is taking place. Learners were conferring within their groups.	✓					
Slow learners struggle with the sentences. More competent learners offer to help those who are struggling.			✓			
More physical interactivity – group went to IWB to sort their task. Learners were busy at the IWB moving items around					✓	

4.3.10 Reflection

According to my observations the emergent structure of the groups seemed to encourage more negotiability than physical interactivity. All the learners were actively involved in discussion amongst the group. The learners who struggled with the construction of the sentence were assisted by their more competent peers. Learners were more relaxed and eager to assist each other when they were working in the emergent group structure.

The outcome of this session was more favourable than the outcomes of the first lesson. The discussion with the observers and changes of the Observer Schedule resulted in the accumulation of more useful data than the 'tally-type' approach that was used during the first lesson. This activity worked well and addressed the need to encourage negotiability and physical interactivity. Although the emergent group learners were more relaxed than during the imposed group structure, the problems that I encountered were that they were talking about off-task issues, laughing and sometimes one of the learners would cause disruptions within the group or walk to the dustbin to throw away papers unnecessarily. To counter this kind of behaviour and encourage more learners to be more focused on the task, I saw the need to adapt my pedagogy to encourage learners to be more focused on negotiability within the emergent groups. During Lesson 2, I instructed learners that they had to read through the article (a comprehension) and appoint leaders within the groups. I decided to try the Multi-choice activity on the Smart Board for the next lesson as I wanted to investigate the value of the emergent group structure with another set of IWB functions.

4.3.11 Lesson 3 Systems and Control: Multi-Choice Activity

4.3.12 Planning

I decided to experiment with the Multi-choice activity on the Smart Board Toolkit because the activity had four possible answers and learners had to choose the correct answer, which would hopefully encourage more negotiability. This activity was based on the Systems and Control module and content specifically focused on the functioning of Hydraulics and Pneumatics. I chose the emergent group structure and added some additional instructions to get learners to be more focused on the activity and participate in a more meaningful manner and to stimulate discussion, hoping to cut out the problems of "unnecessary off-task talking, walking around and disruptive behaviour."

4.3.13. Implementation

I introduced the lesson by reflecting on the activities covered during the previous lessons and highlighting concepts which were mentioned previously (for example hydraulics and pneumatics). This was a follow-up lesson and it consisted of an article "How hydraulics and pneumatics work" (See-Appendix.4.4) which learners read through and discussed within the groups. Furthermore, the article had a set of questions and in order to determine the answers, learners worked through the questions systematically, which elicited negotiability amongst them. After finding the answer to the questions learners would proceed to the IWB and do the Multi-Choice Activity on the Smart Board Toolkit (Figure 4.5).

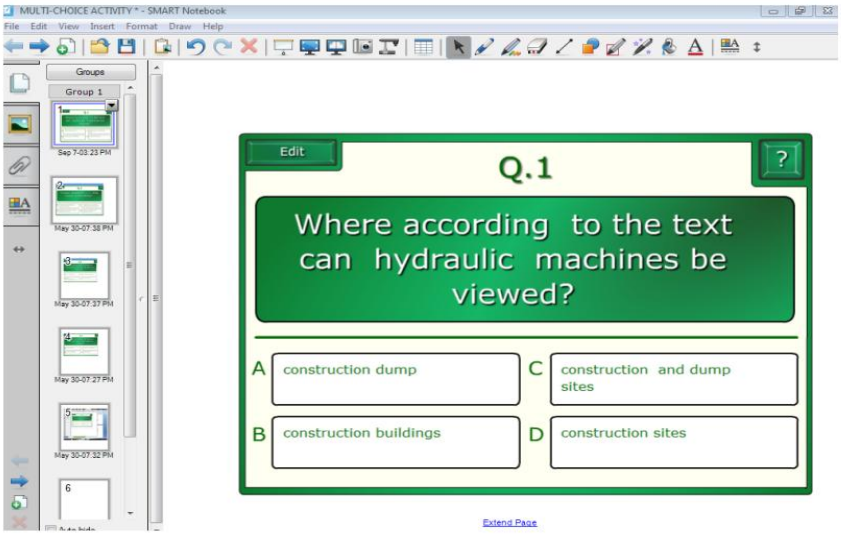


Figure 4.5 Multi-choice Activity on the IWB

4.3.14 Monitoring

4.3.14.1 Observer Schedules

Positive aspects about the negotiability that were noted more frequently during this session were that the "group worked well together, assisting, co-operating; agree about work, co-ordination, organisational skills". A negative aspect pertaining to physical interactivity that was noted more frequently was the "limited physical interactivity". The emergent group structure seemed to elicit a more relaxed atmosphere where learners were more eager to assist each other and participate in group activities than during the imposed group structure

According to the observations the dominant behaviour noticeable during the lesson was the negotiation of tasks (Table 4.8).

Table 4.8 Observer Schedule Intervention 1 Lesson 3 Emergent Structure

Observer			Negotiability				Physical Interactivity		
			Positive		Negative		Positive		Negative
		Comment	✓Discussion / Conversing / Engagement	Group work well together /Assisting / Co operating /Agree about work / Co ordination / Organisational skills	Arguing /Disagreement about task	Reluctance to participate	Learners are dragging items on the IWB /Manipulation of the IWB	Assistance offered	Limited interactivity
A	Group 1	Learners are seated with friends. They are discussing the task. (Comprehension-Hydraulics &Pneumatics). Only one learner is manipulating the IWB.							✓
B		Good coordination between learners. Learners work on the IWB		✓			✓		
A	Group 2	The group is reading the article. They are trying to find the answers. A learner is working on the IWB.		✓					✓
B		Good group work. Learners work on the IWB		✓			✓		
A	Group 3	One learner reads while the rest is listening. Question and answer session follow. One learner assigned to do task on the IWB.		✓					✓
B		Learners take turns. They work well as group. A learner manipulates the IWB.		✓					✓
A	Group 4	Group quarrel. Leader intervenes and sorts out problem. Learner struggle with choice of answer on the IWB. Another assist him			✓			✓	
B		Learners are much more focused. Good working relationship amongst them. Learner working on the board.		✓					
A	Group 5	Group reading aloud and this causes a stir. One learner indicates that she will do the manipulation of the IWB.		✓					✓
B		Learners marked off the words. **Some** disagree about how things are done.		✓	✓				✓
A	Group 6	Group read individually. Discuss as a group. One learner at IWB.		✓					✓
B		Learners display good organisational skills. One learner is busy on the IWB at a time.		✓					✓
A	Group 7	Learners help the slower learners with reading. A learner at the IWB.						✓	✓
B		Learners tick off the words and arrange in structure. Learner can drag items on the IWB.		✓			✓		
A	Group 8	After reading and discussion-one learner doing activity on the IWB		✓					✓
B		Learners are cooperating with each other and assisting one another. One learner is busy at the board at a time.		✓					

4.3.14.2 Journal

According to my journal notes (Table 4.9) a positive aspect about the Multi-choice activity was that it encouraged more negotiability however, a negative aspect of the task was the limited physical interactivity as only one learner from the group could manipulate the IWB at any one time (Table 4.9).

Table 4.9 Journal Entries for Intervention 1 Lesson 3

Comment	Negotiability		Physical Interactivity	
	Positive	Negative	Positive	Negatives
	Discussion		More interactivity	Limited interactivity
More negotiability (reading followed by discussion) occurred before learners went to the IWB.	✓			
Physical interactivity (the activity design only enabled one learner to do the manipulation on the IWB) is somewhat limited.				✓
NB! I chose to develop activities that will support more physical interactivity.				
Review: session and make changes where possible in order to reach outcome.				

4.3.15 Reflection

Both the Mix and Match (Lesson 1) and the Multi-choice (Lesson 3) activities on the *Smart Board toolkit* limited the physical interactivity compared to the 'Unjumbling' activity (Lesson 2). Lessons designed using the IWB built-in toolkit do not necessarily elicit negotiability or physical interactivity. In order to promote a more learner-centred approach, the design of lessons should be structured to encourage more negotiability by providing group activities where learners can talk about what they are doing and in this way encourage learner discussion and contribution towards completion of the given task. In order to encourage favourable opportunities for physical interactivity, lessons need to use the functions of the IWB that allow all the learners within a group to manipulate the IWB and work toward completion of the task on the IWB together.

4.3.16 Learner Questionnaires

According to the Learner Questionnaire that was completed after the first intervention and about the imposed group structures the responses to the question: ”How well did you work in your group?” were as follows. Forty-two percent of the 41 learners indicated that they worked quite well; 46% responded that they worked ‘well’; 12% of the learners responded that they did ‘not (work) so well’ in their groups (Table 4.10)

Table 4.10 Learners' perceptions on how well they worked in the imposed groups

LQ1 IS 1st Intervention : How well did you work in your group?		
Quite well	Well	Not so well
42%	46%	12%

In relation to the Emergent group structures the learner questionnaires reflected the following responses to the question: ”How well did you work in your group?” were as follows. Twenty-four percent of the 41 learners indicated that they worked quite well; 76% of the learners responded that they worked ‘well’ in their groups. None indicated that they did not work so well in their groups (Table 4.11).

Table 4.11 Learners’ perceptions on how well they worked in the emergent groups

LQ1 ES 1st Intervention : How well did you work in your group?		
Quite well	Well	Not so well
24%	76%	0%

Responses to the question: ”Could you air your views in the group. Say freely what you feel?” produced the following findings. Sixty three percent of the 41 learners indicated “yes”; 10% of the 41 learners responded “sometimes” and 27% of the learners in the imposed groups did not feel they could respond freely, which is an indication that the imposed structure limited negotiability (Table 4.12).

Table 4.12 Learners' perceptions on could they air their views in the imposed groups

LQ2 IS 1st Intervention : Could you air your views in the group. Say freely what you feel?”		
Yes	Sometimes	No
27%	63%	10%

Responses to the question: ”Could you air your views in the group. Say freely what you feel?” produced the following findings. Ninety-three percent of the 41 learners indicated “yes”; 7% of the 41 learners responded “sometimes” in their groups. None of the learners said they were unable to air their views freely in the emergent groups (Table 4.13)

Table 4.13 Learners' perceptions on could they air their views in the emergent groups

LQ2 ES 1st Intervention : Could you air your views in the group? Say freely what you feel?”		
Yes	Sometimes	No
93%	7%	0%

Responses to the question: “Did you enjoy working as a group on the IWB?” showed that 63% of 41 learners indicated “yes”, while 27% out of 41 learners responded with “sometimes” and 10% of 41 learners responded with a “no”. An unusual finding during the imposed group structure had a favourable influence on the engagement of learners while they were interacting with the IWB (Table 4.14).

Table 4.14 Learners' perceptions on whether they enjoyed working as an imposed group on the IWB

LQ2 ES 1st Intervention : Did you enjoy working as a group on the IWB as an imposed group?		
Yes	Sometimes	No
63%	27%	10%

Responses to the question: “Did you enjoy working as a group on the IWB?” indicated that 98% of 41 learners suggested “yes”, 2% out of 41 learners responded with “sometimes”. The 98% who responded with a “yes” is an indication that working as a group in the emergent structure shows learners really enjoys working with friends, increasing negotiability among the learners (Table 4.15)

Table 4.15 Learners' perceptions of whether they enjoyed working as an emergent group on the IWB

LQ2 ES 1st Intervention : Did you enjoy working as a group on the IWB as an emergent group?		
Yes	Sometimes	No
98%	2%	0%

4.3.17Focus group interviews

The focus group questions were analysed and coded as discussed in Chapter 3; an example of the coding (See Appendix 4.7) is attached. During the focus group interviews the following question: “How well did

teacher present Technology using the IWB compared to the previous year's Technology Sessions?" was posed and the following responses were received. Five out of eight learners mentioned the teacher's "ease of use of the IWB" while 4 learners mentioned the interactive ability of the IWB (Figure 4.6).

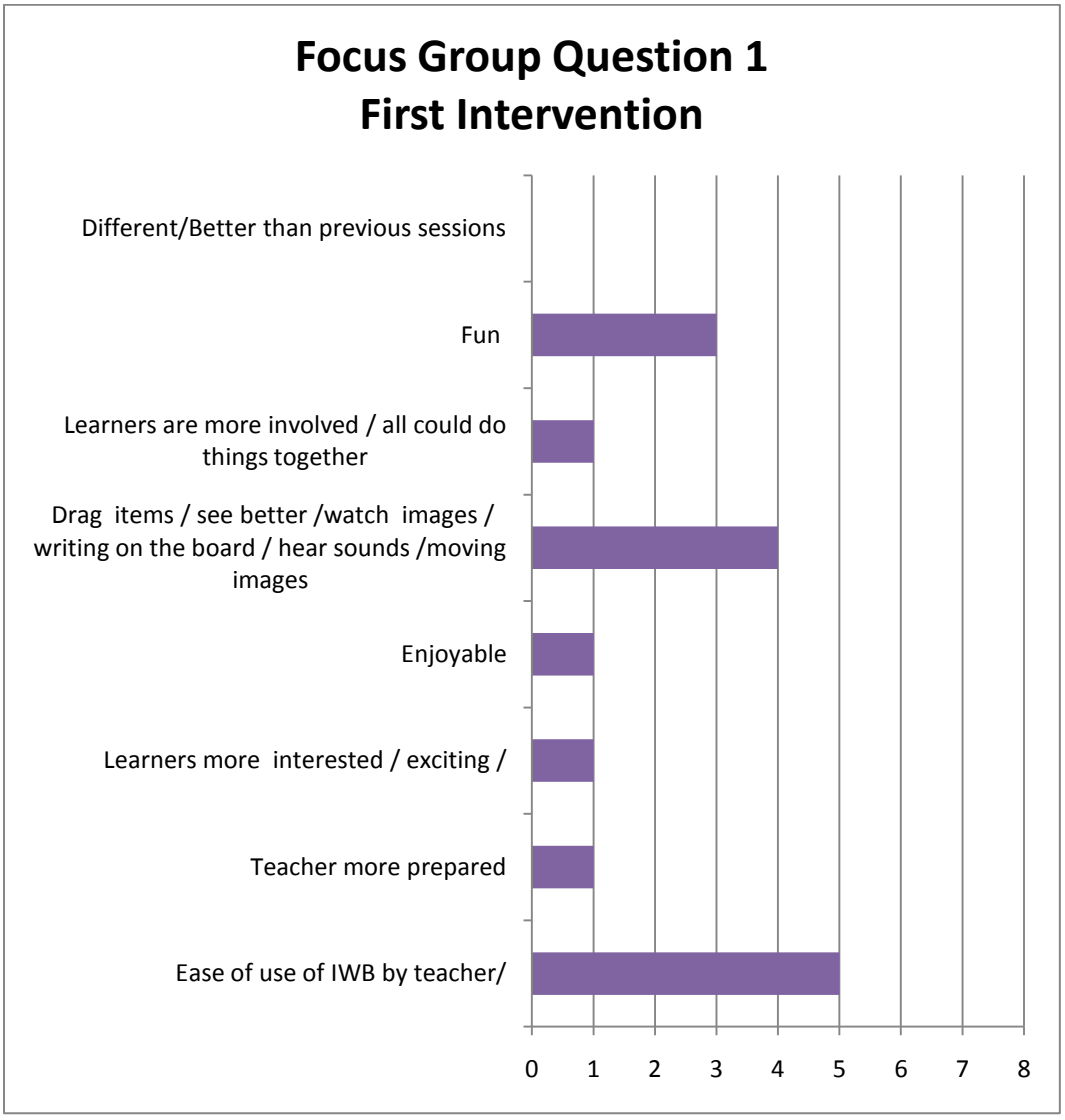


Figure 4.6 Intervention 1 Learners' Response to FGQ1

The next question posed to the eight learners: “How did you find working in the emergent groups?” revealed the following responses. Three out of eight learners indicated that their group “worked well” as they “worked as a team” and “helped each other” and this can be ascribed to the relaxed atmosphere that learners experienced in the emergent group structure (Figure 4.7).

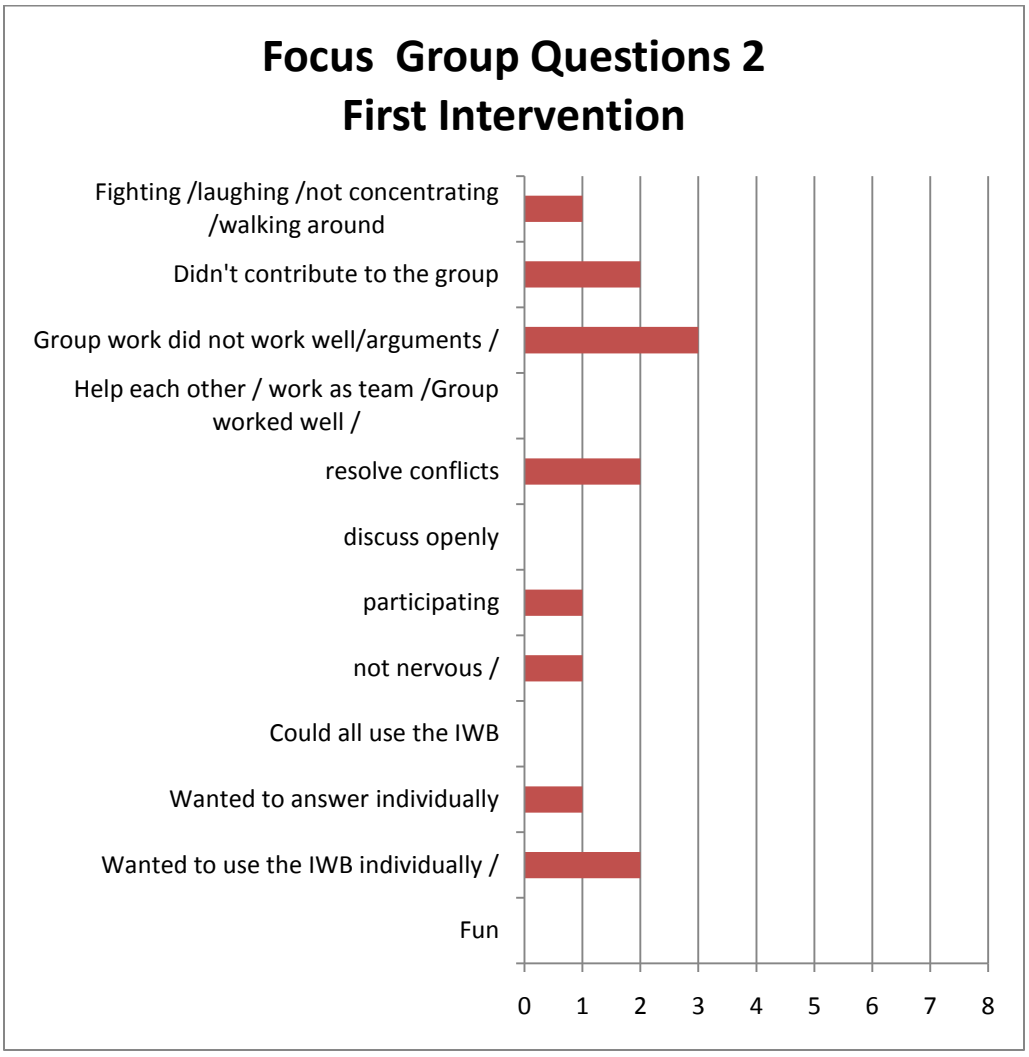


Figure4.7Intervention 1 Learners' Response to FGQ2

Responses to the third question: “How did you find working in the imposed groups?” revealed the following: six of the learners mentioned that working in the imposed structure was not fun and not enjoyable. This is an indication that the imposed group structure hindered negotiability as learners’ level of participation in group activities were inhibited (Figure 4.8).

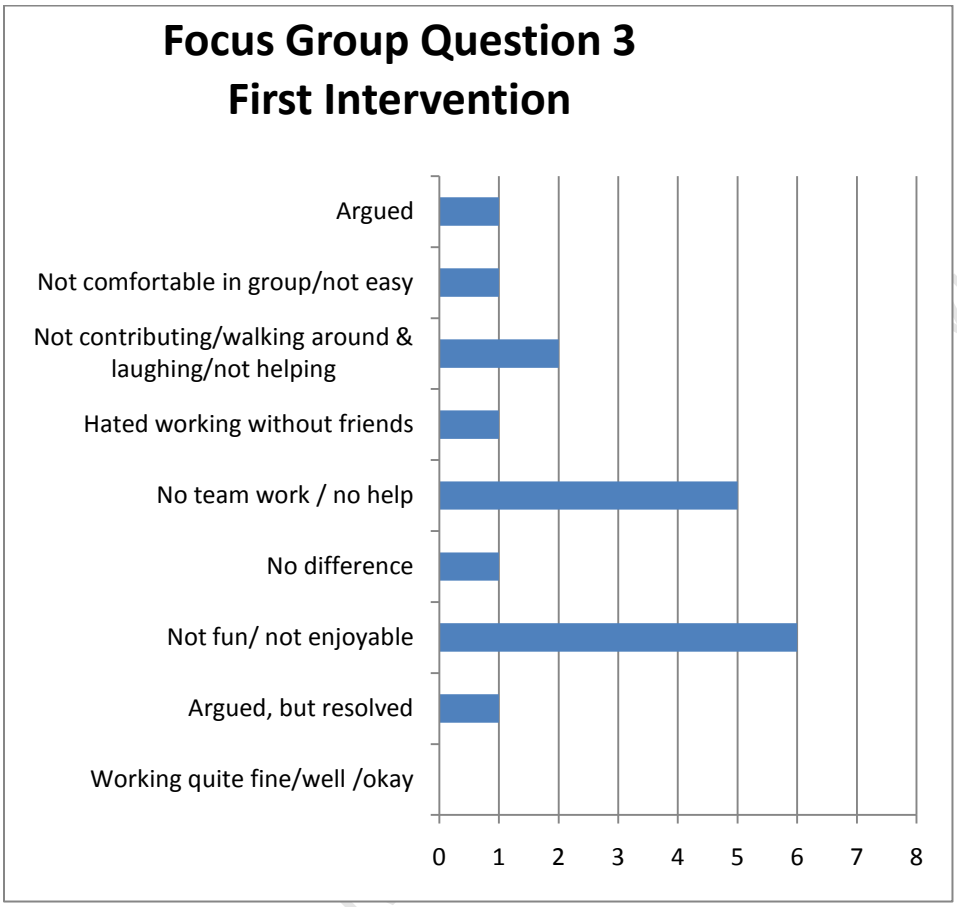


Figure4.8 Intervention 1 Learners' Response to FGQ3

4.3.18 Reflection of the first intervention

At the start of the investigation I was totally unaware of what to expect while introducing the IWB in my classes. Positive aspects noted during the intervention were that learners were more relaxed during the emergent group structure activities and they were more willing to assist each other during their interactions. Learners were more ready to air their views during the emergent than during the imposed group structures, which could be regarded as favourable for negotiability.

A negative aspect of the intervention was noted during the first lesson when the observers used the 'tally-type' approach and not sufficient and detailed information was indicated on their schedules. Other negatives noticed during this intervention were the off-task talking which occurred when learners were not focused on the given task and limited interactivity. In order to counter the above negative aspects I had to review my pedagogy and modify the Observer Schedules and converted it from a 'tally-type' approach to include a more detailed analysis of what was actually happening during the sessions while learners were negotiating. The lesson design had to be changed to include more focused reading (for example a comprehension passage) to counter the unnecessary talking and changing the lesson structure to include more interactive activities (for example Unjumbling activities where I implemented and created my own structure) to elicit more physical interactivity.

I decided to include the above changes into the next intervention and to switch to the Processing module to experiment with a variety of content within Technology. After reviewing the observations I would say that in order to elicit more physical interactivity it is not so much the group work that is important, but the opportunity for each learner to have a chance to use the interactive whiteboard. The outcome of this intervention has shown that the design of the IWB activity, (i.e. the Unjumbling and my own created Mix and Match activity) has encouraged additional physical interactivity. The group structure, on the other hand, definitely determined the level of negotiability.

4.4 Second intervention

4.4.1 Lesson 1 Processing: Unjumbling Activity

4.4.2 Planning

I decided to use the 'Unjumbling' principle due to the favourable *negotiability* and *physical interactivity* it encourages. The *imposed* structure was used for this lesson because I wanted to see how the learners function within a teacher-directed setting and I needed more data on negotiability and physical interactivity within the imposed group setting. A PowerPoint presentation (See Appendix 4.5) was once

again used for the introduction and different food types were shown to learners to demonstrate how foods were preserved. For this lesson learners had to 'Unjumble' the definition of the concepts and to enable more learners to interact with the IWB, each group had to rearrange the structure of a sentence. A formal test which formed part of the term assessment and based on the Processing module would be written at the end of the intervention.

4.4.3 Implementation

I divided the class into the *imposed* structure groups and introduced the lesson explaining concepts pertaining to the Preservation of foods (See Appendix 4.4 and 4.5). In addition, I showed the learners real food products that had been preserved by means of drying, freezing, etc.

Existing concepts were displayed on the IWB and learners had to rearrange the structure of the sentence in order for the sentence to make sense. I also informed learners about the formal assessment (Figure 4.9).

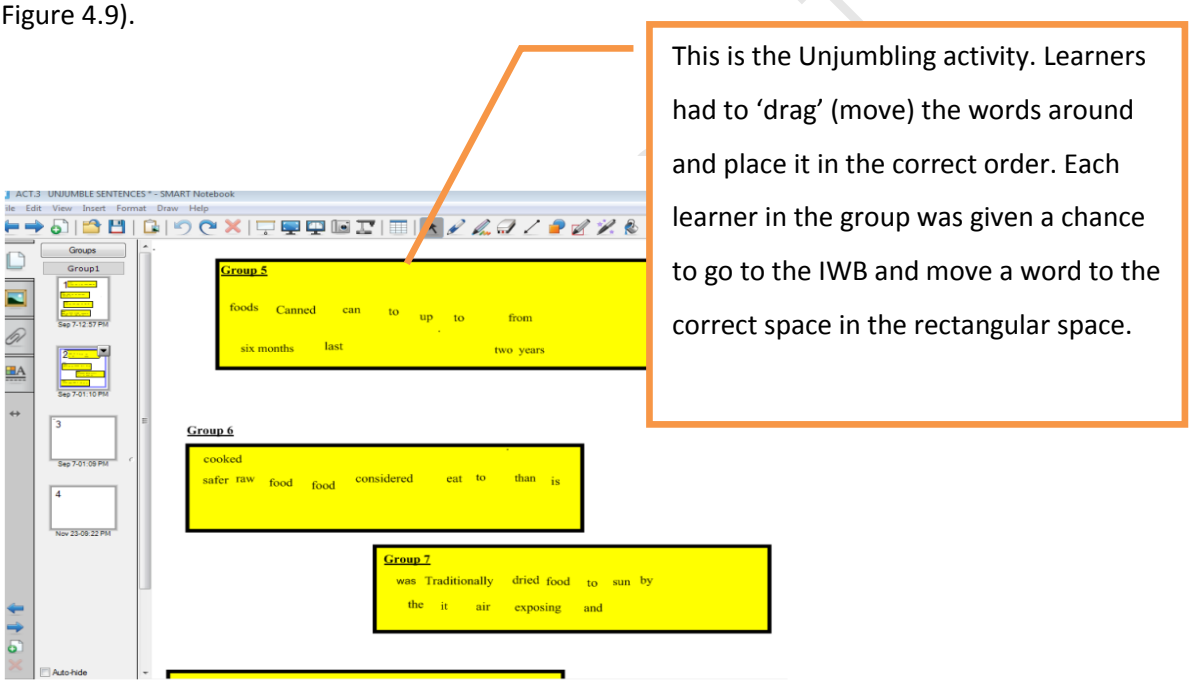


Figure4.9Unjumbling Activity on the IWB

4.4.4 Monitoring

4.4.4.1 Observer Schedules

The positive aspects noted during negotiations were “Lots of discussion, shared ideas, guided one another, assisted each other, conversing”. A positive aspect noted with respect to physical interactivity was the “ability to use the IWB” (Table 4.16).

Table 4.16 Observer Schedule Intervention 2 Lesson 1 Imposed Structure

Observer			Negotiability				Physical Interactivity		
			Positive			Negative	Positive		Negative
		Comment	Active participation/ / Input given / group work	Lots of discussion/shared ideas /guided one another/ Assisted each other /conversing	Arguing	Disruptive behaviour	Assisted each other at the IWB	Able to use the IWB	Difficulty in dragging objects Struggled with answer at IWB/ learners in a hurry to finish task
A	Group 1	Group work together to get to the answer. Tried many ways to get to the answer. Were able to use the IWB. They drag items around.	✓					✓	
B		While at the board (IWB) learners assisted one another. Interactivity noted in this group.		✓			✓		
A	Group 2	Lots of discussion. Everyone involved in discussion. Learners were able to move objects around on the IWB		✓			✓		
B		Learners were busy dragging and matching items					✓		
A	Group 3	Active participation amongst group. Lots of arguing about who must go to the board.	✓		✓				
B		Group worked toward formulating an answer. They used the IWB pens and even the back of their fingers.	✓	✓				✓	
A	Group 4	Learners shared ideas on how they going to answer the question. Actively involved in discussion. Learners in a hurry to finish work on board.		✓					
B		Group worked well together and shared ideas in finding an answer. Learners in a hurry to complete task.	✓	✓					✓
A	Group 5	Lots of discussion. Struggled with answer on the IWB.		✓					
B		Pupils were able to decide on answer. Some were disruptive. Impressive show of interactivity, learners manipulated the IWB.				✓		✓	
A	Group 6	Learners in this group guided one another until they found the correct answer. Learners struggled to move images around on the IWB.		✓					✓
B		Learners in this group were conversing with each other. They asked questions to get to the answer. Learners are busy at the IWB. Everyone in group was given a chance to work on the IWB.		✓				✓	
A	Group 7	Learners engaged in discussion. Each learner had the opportunity to use the IWB. They dragged the items and place them in correct order.		✓				✓	
B		Collaboration takes place amongst learners. Manipulations of the IWB take place.		✓				✓	
A	Group 8	Learners assisted one another. While at the board (IWB) learners assisted one another.						✓	
B		Learners were consulting with each other. Each learner in this group was given an opportunity to work on the IWB.		✓				✓	

4.4.4.2 Journal

The Unjumbling approach encouraged more positive aspects of negotiability namely discussions were noted and learners offered to assist each other even though it was the imposed structure. With regard to physical interactivity the positive aspect of "more interactivity" was noted meaning that more learners were able to manipulate the IWB (Table 4.17).

Table 4.17 Journal Entries Intervention 2 Lesson 1

Comment	Negotiability			Physical Interactivity	
	Positive		Negative	Positive	Negatives
	Discussion	Assistance offered		More interactivity	Limited interactivity
Unjumbling activity encouraged more negotiability (discussion and chatting)	✓				
The more competent learners assisted those who were struggling					
This activity also allowed more interactivity because more learners were able to do the task on the IWB.				✓	

4.4.5. Reflection

This structure of the Unjumbling activity lesson allowed more negotiability and physical interactivity than during the imposed structure. The mere fact that learners were expected to participate in the learning activities as they had to be formally assessed afterward encouraged them to contribute. With regard to the negotiability aspect learners showed a lack of enthusiasm at the start of session as they were not seated with their peers since this was an *imposed* structure. The lesson structure enabled more learners to negotiate because it was expected of them to place the different words which were muddled up in the correct order. All of the learners within a group also had the opportunity to participate in manipulation of the IWB because each learner had to move the different words to the correct spaces. Observations mentioned the positive aspects of negotiability and physical interactivity. I decided to use the Mix and Match Activity in the following lesson to investigate the possibility of eliciting the same favourable outcomes of negotiability and physical interactivity.

4.4.6 Lesson 2 Processing: Mix and Match Activity

4.4.7 Planning

Even though the Mix and Match activity on the Smart Board Toolkit just allowed one learner to manipulate the IWB, I had to amend the design and develop a Mix and Match activity for the IWB that would allow more physical interactivity. In order to do that I used the Built-in Toolkit and implemented my modified Mix and Match activity. This activity entail that learners had to match different images with the correct concept. Various images pertaining to preservation of foods, i.e. drying, canning, bottling, frozen, etc. were used for this activity. I decided to use the emergent structure for this session because I needed more data on how the IWB as a tool would encourage negotiability and physical interactivity during the emergent structure. I created the Mix & Match activity to enable additional physical interactivity.

4.4.8 Implementation

For this activity learners had to go up to the IWB and drag the correct picture that matches the descriptor and with the picture (Figure4.10).

I modified the version of the Mix and Match activity, so that additional physical interactivity could be elicited.

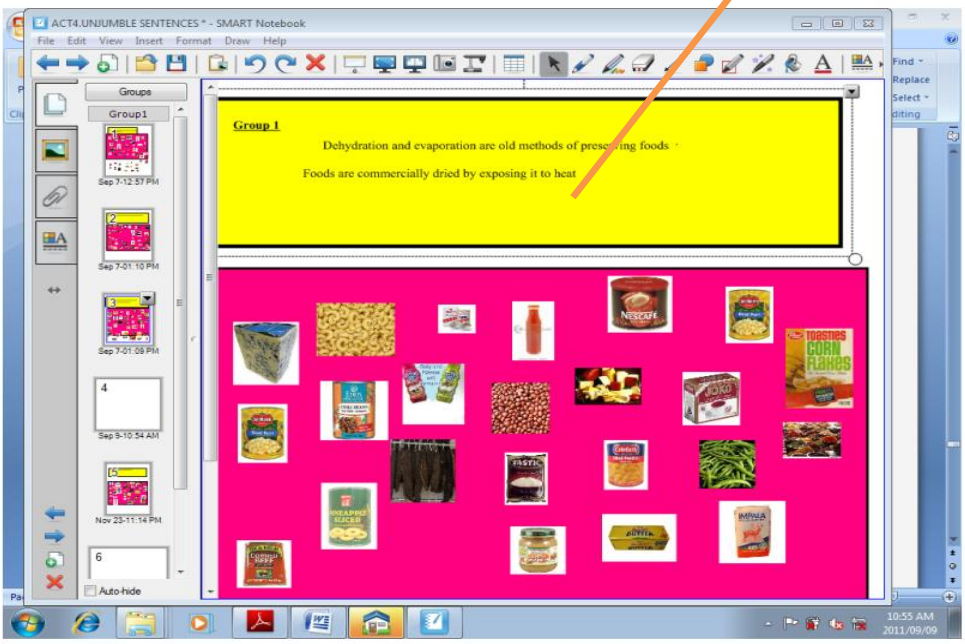


Figure 4.10 Mix and Match Activity on the IWB

4.4.9 Monitoring

4.4.9.1 Observer Schedules

The positive aspects noted pertaining to negotiability: ”Lots of discussion, shared ideas, guided one another, assisted each other, conversing, conferring ”. The positive aspect noted with respect to physical interactivity is the ability to use the IWB and “dragging” items on the IWB (Table 4.18).

Table 4.18 Observer Schedule Intervention 2 Lesson 2 Emergent Structure

Observer			Negotiability			Physical Interactivity		
			Positive		Negative	Positive		Negative
		Comment	Active participation/ / Input given	Lots of discussion/shared ideas /guided one another/ Assisted each other /conversing / conferring	Arguing	Assisted each other at the IWB	Able to use IWB/Drag objects /	Disruptive behaviour
A	Group 1	Learners were interacting and discussing the Mix & Match task. Learners went to IWB. They take turns in dragging items.		✓			✓	
B		In this group learners tried to analyse what they must do. Group assists one another with the task at the IWB.		✓				
A	Group 2	The group was busy talking about what they need to do about the task. Learners are moving items around on the IWB		✓			✓	
B		Learners tried to probe possible ways of finding a solution. Learners at the IWB-manipulating the items.		✓			✓	
A	Group 3	Learners were talking and one explained to the other what they need to do. Some make mistakes by placing items in wrong spaces. Others assist them at IWB.		✓		✓		
B		Learners were eager to start with the activity They were conversing about the given activity. Manipulation of the IWB. Learners in group are taking turns to go to IWB.		✓			✓	
A	Group 4	Learners were engaged in talking about the given task. Learners taking turns to complete the sentence on the IWB.		✓			✓	
B		The participants started conferring with one another. Learners in group are all at the IWB- taking turns to do their part.		✓			✓	
A	Group 5	The learners were chatting about how they are going to do the work. Some disagreement was noticeable within the group. Some learners are struggling with the sentence. The rest of the group is eager to help them.		✓	✓	✓		
B		Eager participation-learners chatting about how to Mix & Match activity. Learner involvement noticeable, learners assist those who are struggling	✓	✓				
A	Group 6	Group was involved in analysing the task. Learners are busy at the IWB trying to figure out where they must place the word	✓				✓	
B		Some arguing about who must do what part of task. Some learners were not participating. Learners were working on the IWB.			✓		✓	
A	Group 7	This group listened while each learner described what needs to be done. Learners are all involved in what is being done at the IWB.	✓				✓	
B		Learners were engaged in chatting about the activity. Each learner took turns to go to the IWB to complete the task. Matching the items.	✓				✓	
A	Group 8	Learners were involved in discussion. Learners at the IWB to complete the task.		✓			✓	
B		Group busy and engage with task. Unnecessary walking around (one learner). Learner involvement noticeable-learners assist those who are struggling.						✓

4.4.9.2 Journal

The positive aspects of negotiability and physical interactivity were noticeable (Table 4.19).

Table 4.19 Journal Entries for Intervention 2 Lesson2

Comment	Negotiability			Physical Interactivity	
	Positive		Negative	Positive	Negatives
	Discussion	Co-operation / Participation		More interactivity/ IWB manipulation	Limited interactivity
More negotiability in groups was visible. Learners were chatting about the given task.	✓				
Physical interactivity on the IWB was noticeable as learners 'drag' items and match it with the descriptors.				✓	
Class – hive of activity-lots of movement to- and- fro to manipulate the IWB		✓		✓	
Good co-operation from learners		✓			

4.4.10 Reflection

Physical interactivity was evident since the wide variety of items of the Mix and Match activity enabled all the learners within each of the eight groups to manipulate and drag items to the yellow box that defined the preservation concept. This activity enabled all the learners in each group to go up to the IWB and manipulate it. The design of the activity encouraged additional physical interactivity amongst learners as a variety of items in a pink textbox had to be matched to the descriptor in the yellow box. According to the Observers schedules, learners were collaborating and assisting each other while they were working. Some learners were arguing about the task, which was an indication that negotiations were taking place.

This lesson showed that negotiability and physical interactivity could be enabled if the design of the lesson is structured in such a manner that will elicit the above-mentioned features and this spurred me on to experiment with a new lesson to investigate the possibility of encouraging the same outcomes.

4.4.11 Lesson 3 Processing: Flow Charts: Material & Tool Lists

4.4.12 Planning

A section of LO 2 of Technology expects learners to analyse the manufacturing process by drawing up a *material list* and a *tool list*.

In this instance data was provided (a PowerPoint Presentation (See Appendix 4.6) outlined Lesson 3) and learners had to use the given data, analyse it into a *material list* (ingredients) and *tool list* (cooking equipment) and thereafter write out a *flow chart* explaining how the meal will be made. This activity had to be done on the IWB and each learner would be given a hard copy of the activity. The imposed structure was used during this activity since I required more data on how a teacher-initiated group structure could be used to encourage negotiability and physical interactivity.

4.4.13 Implementation

Learners had to go to the IWB and do the actual activity on the IWB by using the IWB pen to write on the IWB (Figure 4.11).

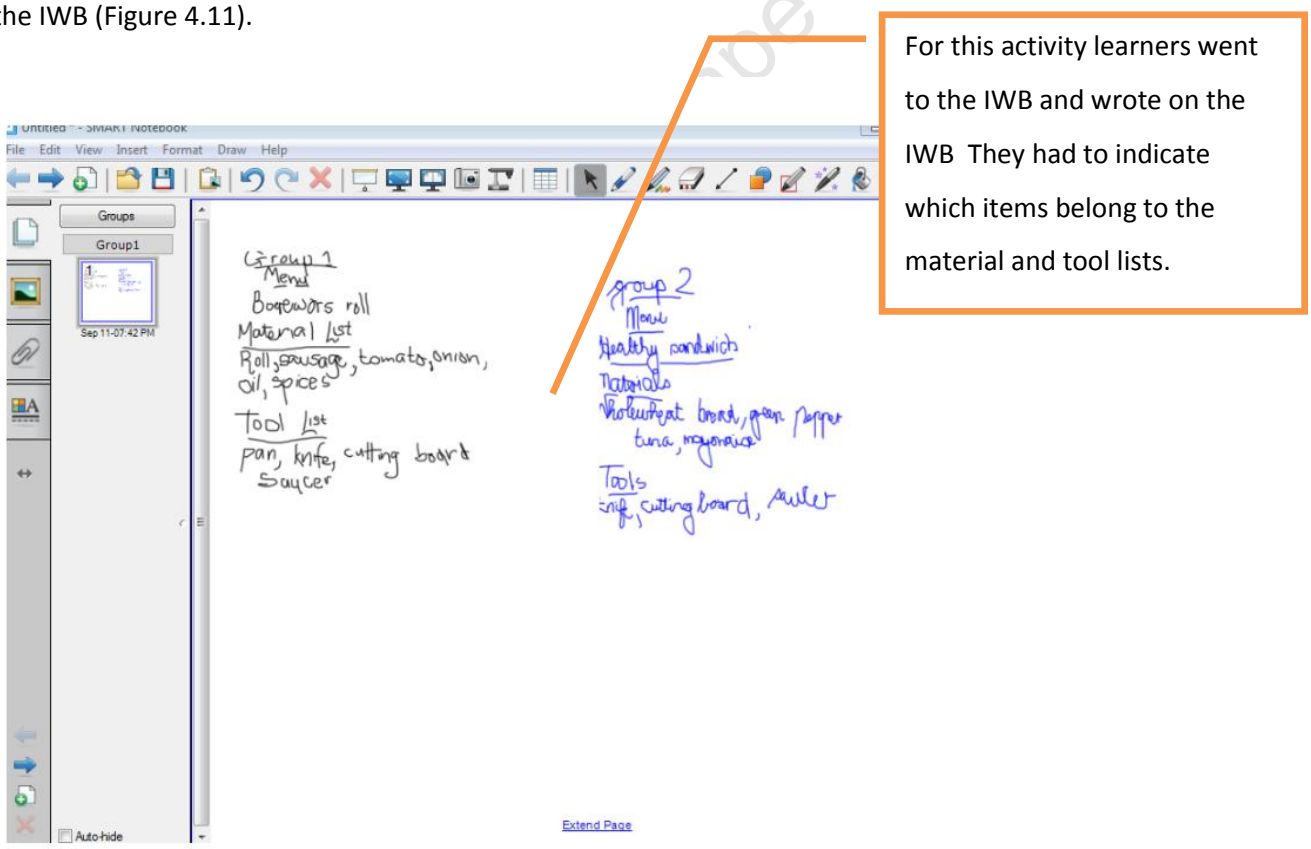


Figure4.11Flow Chart, Material and Tool List Activity on the IWB

4.4.14 Monitoring

4.4.14.1 Observer Schedules

The observations accentuated the positive aspects of both negotiability and physical interactivity and the negative aspect of disruptive behaviour was noted while learners were negotiating. A negative aspect pertaining to physical interactivity was that learners “struggled to write on the IWB” (Table 4.20).

Table 4.20 Observer Schedule 2 Lesson 2 Imposed Structure

Observer			Negotiability		Physical Interactivity	
			Positive	Negative	Positive	Negative
		Comment	Engagement /Group work / Conversing/ discussion	Disruptive behaviour	Manipulation of the IWB	Struggle to write on the IWB
A	Group 1	Two learners fighting in group. They settled down. Commence with task. Learners at the IWB writing on the IWB.		✓	✓	
B		Learners were engaged with dividing items under the different headings. All the learners went to IWB. Some of them struggled to write on the IWB.	✓			✓
A	Group 2	Learners working together. They are busy with listing items under Materials & Tools list. Group at the IWB-each one got a chance to work on the IWB.	✓		✓	
B		Learners were engaged with in chatting about the task. Learners are writing on the IWB	✓		✓	
A	Group 3	Group busy with analysis of the different items that must be listed. Learners were each given an opportunity to go to the IWB and manipulate it.	✓		✓	
B		Group involve in chatting about what is expected from them and how they are going to solve the problem. The group is at the IWB-writing on the board	✓		✓	
A	Group 4	Learner engagement is noticeable-discussing who is going to tackle the different sections of the activity. Learners at the IWB; some write with pen and others use their finger.	✓		✓	
B		Discussion taking place amongst learners. One learner read the instructions while the others are listening. Some of them are struggling to hold IWB pen. Others show them how.	✓			✓
A	Group 5	Learners are discussing the task. Two of them are arguing about the choice of items. Learners are writing and placing items under heading.	✓	✓	✓	
B		Group was busy discussing how they going to do the task. Each one were granted an opportunity to do their bit in completing the task	✓			
A	Group 6	All learners involved in discussion. Some of them are giggling. All of them were given an opportunity to write on the IWB.	✓		✓	
B		This group was busy discussing what task they needed to do. Even though some are struggling, they are eager to work on the board.	✓		✓	
A	Group 7	Learners involved in working out what they need to do for their section of the task. Group work well together-assist each other.	✓		✓	
B		Everyone involved and listening and participating in group discussion. Learners are eager to assist those who are struggling to write on the IWB.	✓		✓	
A	Group 8	Enthusiastic learners in discussion with each other. Two are chatting about non-work related things. Learners given opportunity to work on the IWB.	✓		✓	
B		Learners involved in describing what they need to do. The group are able to write on the IWB	✓		✓	

4.4.14.2 Journal

Positive aspects noted for negotiability which included “discussion, assistance offered and learners were interacting”. A positive aspect namely “more interactivity” was noted that more learners were manipulating the IWB (Table 4.21).

Table 4.21 Journal Entries Intervention 2 Lesson 2

Comment	Negotiability			Physical Interactivity		
	Positive		Negatives	Positive	Negatives	
	Interacting	Assistance offered		More interactivity	Limited interactivity	Struggling with IWB pen
Learners assistance noted		✓				
Some learners were not good readers then the more competent readers would assist them. Those struggling were supported.		✓				
Some tasks entailed writing on the IWB and in some groups they struggled to hold the IWB pen. In these instances the more competent would guide them to hold the pen correctly.				✓		✓
Good negotiability. Learners were interacting with each other and planning how they would do the task on the IWB. Interactivity on the IWB always consisted of dragging items and matching it in the different types of activities.	✓			✓		

4.4.15 Reflection

The Analysis of the Flowchart allowed more negotiability because the structure enabled more learners to negotiate since it was expected of them to place the different words which were muddled up in the correct order. With regard to the negotiability aspect learners showed a lack of enthusiasm at the start of session as they were not seated with their peers since this was an *imposed* structure. All of the learners within a group also had the opportunity to participate in manipulation of the IWB because each learner had to move the different words to the correct spaces. The analysis of the Flowchart elicited a favourable amount of negotiability and physical interactivity amongst learners and I needed to create a variety of lesson designs that would address the need for more learner involvement pertaining to negotiability and physical interactivity.

4.4.16 Learner Questionnaires

The responses to the learner questionnaire on the imposed group structure the question: "How well did you work in your group?” showed that 37% of the 41 learners responded that they worked “well”, 36%

of the 41 learners indicated that they worked quite well; 27% of the learners responded that they did not work “not so well” in their groups. The positive responses “quite well and good/well” indicated that negotiability occurred during the imposed structure (Table 4.22).

Table 4.22 Learners' perceptions on whether they enjoyed working as an imposed group on the IWB

LQ1 IS2nd Intervention : **How well did you work in your group**?		
Quite well	Well	Not so well
36%	37%	27%

Emergent Structures: Learner Questionnaire 1

Findings revealed that 51% of the 41 learners indicated that they worked “quite well”, 44% of the 41 said that worked “well” and 5% of the 41 learners stated that they did not work well in the group during the emergent structure. The overall positive findings indicated that learners worked well within the emergent group structure (Table 4.23).

Table 4.23 Learners' perception of how well they worked in the emergent groups

LQ1 IS2nd Intervention : **How well did you worked in the emergent groups**?		
Quite well	**Good/well**	**Not so well**
51%	44%	5%

Imposed Structures: Learner Questionnaire 2

The findings showed that 49% of the 41 learners indicated with a “yes” while 34% of 41 indicated with “sometimes “ and 17% of 41 learners indicated with “no” that they could air their views within the groups. This is an unexpected outcome and indicates that learners were able to air their views in the imposed group structure (Table 4.24).

Table 4.24 Learners' perception could air their views within the imposed groups

LQ2 IS2nd Intervention : **Could air their views within the groups/Say what you want to say**?		
Yes	**Sometimes**	**No**
49%	34%	17%

Emergent Structures: Learner Questionnaire 2

The responses confirmed that 56% of 41 learners indicated “yes” while 24% of 41 learners stated “sometimes” and 20% of 41 learners said “no” when asked if they could air their views during the emergent structure. The 20% who could not air their views freely could perhaps be ascribed to learners arguing during the negotiation phase (Table 4.25)

Table 4.25 Learners' perception could air their views within the emergent groups

LQ2 ES2nd Intervention : **Could air their views within the groups/Say what you want to say**?		
Yes	**Sometimes**	**No**
56%	24%	20%

- **Imposed Structures: Learner Questionnaire 3**

The overall findings indicate that 44% suggest the learners did enjoy working as a group, even though 24% of the imposed group said they did not. This is an indication that the imposed group structure may hinder group work and may have a negative impact on learners working in a teacher-directed structure (Table 4.26).

Table 4.26 Learners' perceptions of how well they worked in the imposed group on the IWB

LQ3 IS2nd Intervention : **Did you enjoy working as a group on the IWB**?		
Yes	**Sometimes**	**No**
44%	32%	24%

- **Emergent Structures: Learner Questionnaire 3**

The findings revealed that 54% out of 41 indicated “yes”; 44% out of 41 stated “sometimes” and 2% out of 41 learners said “no” when asked whether they enjoyed working as a group on the IWB. The 2% “no” can perhaps be attributed to learners arguing during negotiations or the disruptive behaviour which occurred in certain groups (Table 4.27).

Table 4.27 Learners' perceptions of how well they worked in the imposed group on the IWB

LQ3 ES2nd Intervention : **Did you enjoy working as a group on the IWB**?		
Yes	**Sometimes**	**No**
54%	44%	2%

4.4.17 Focus Group Questionnaires

The responses to the question: “How well did teacher present Technology Education using the IWB?“revealed that seven out of eight learners mentioned that they could “drag items, see better, watch images, and write on the board”, and these aspects can be linked to the physical interactivity features of the IWB (Figure4.12).

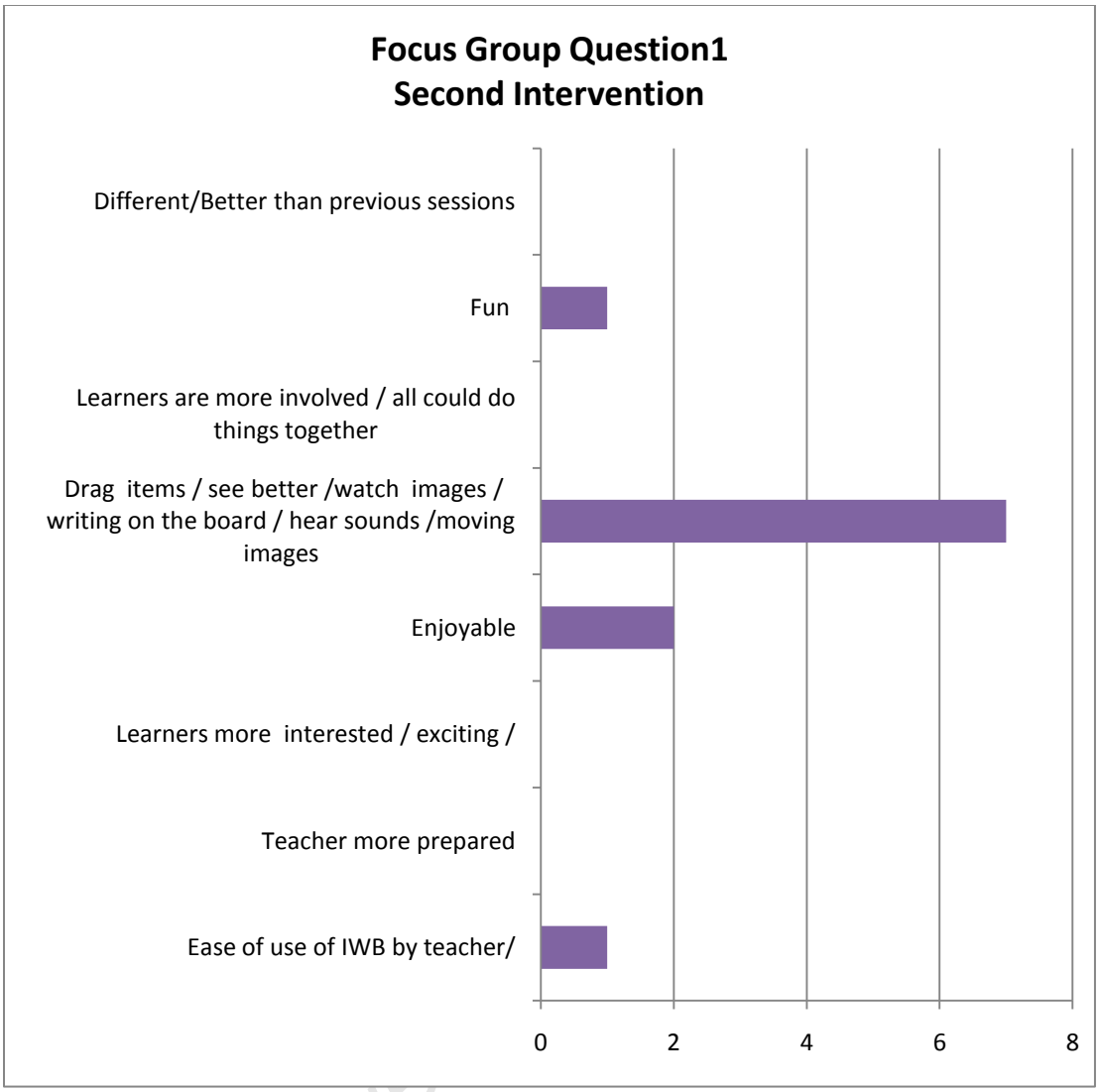


Figure4.12 Intervention 2 Learners' Perceptions FGQ1

In response to the question: ”How did they find working in the emergent structure?” revealed that the 8 learners mentioned that they “helped each other, worked as a team and that the group worked well together”. This positive response can be ascribed to the emergent group structure (Figure4.13).

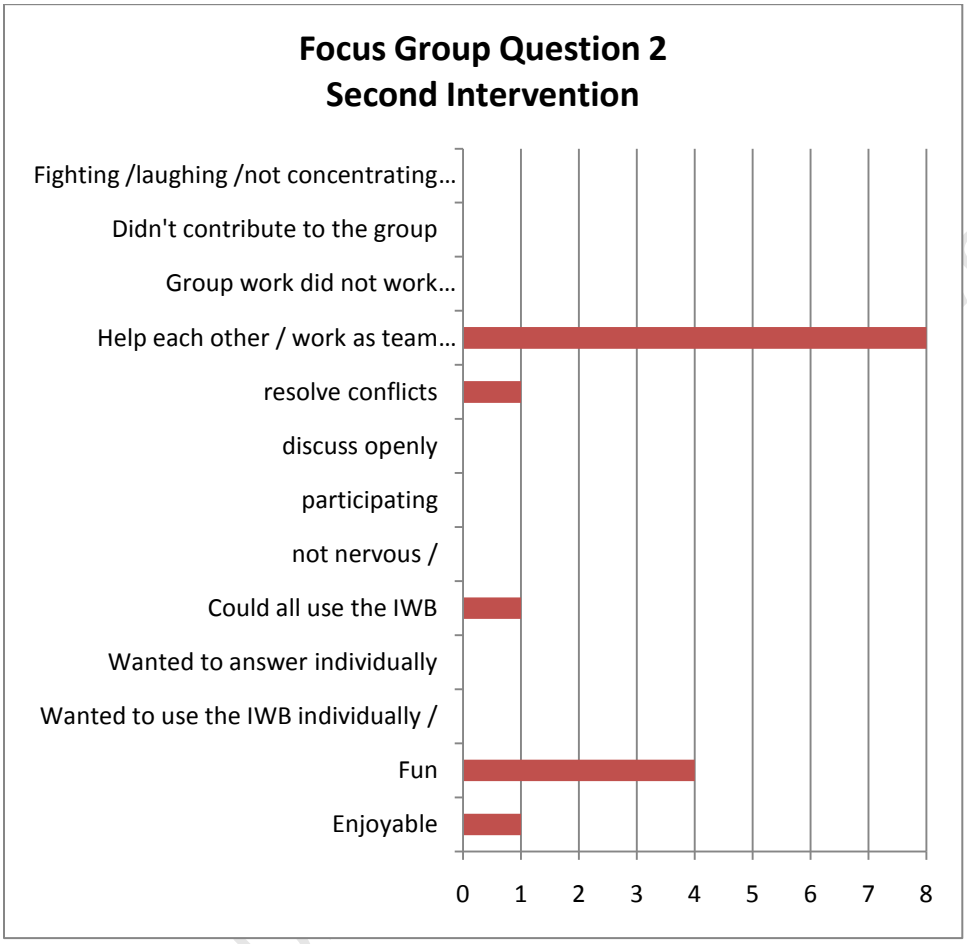


Figure4.13 Intervention 2 Learners' perceptions FGQ2

Responses to the question: “How did they find working in the imposed structure?” showed that seven out of the eight learners mentioned that they were "working quite fine, well and okay”. One mentioned that he/she was “not comfortable in the group” and that it was “not easy” to work in this structure. The imposed group structure has a tendency to hamper group work (Figure4.14).

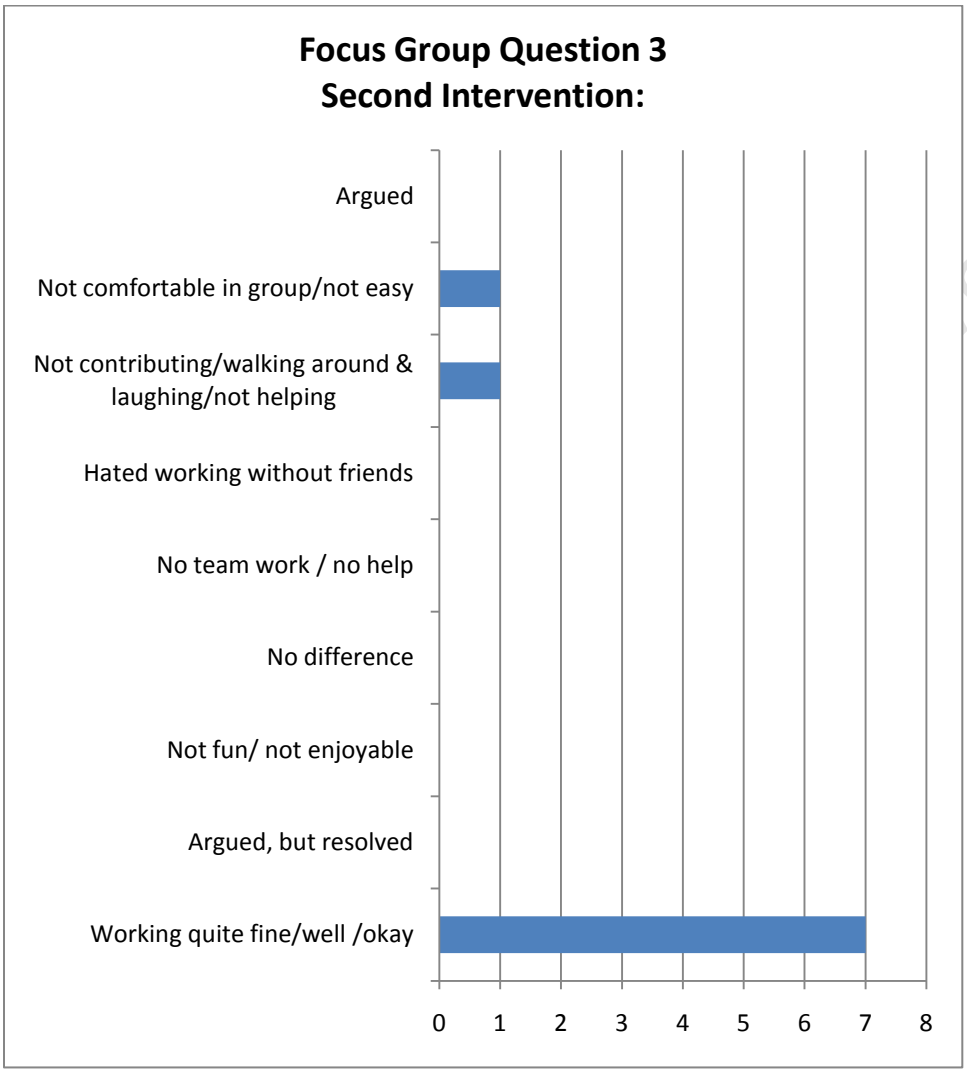


Figure4.14Intervention 2 Learners' perception FGQ 3

4.4.18 Reflection of the second intervention

There has been a vast improvement on the activities and observations during the second intervention. The Unjumbling activity of the Processing module was well executed and the amended Mix and Match activity allowed for more interactivity. Valuable data was retrieved from observation schedules, learner questionnaires and focus group interviews. In order to see how effective the introduced pedagogical changes were during this intervention, I decided to go back to the field and collect more information regarding my pedagogy and see how precise my assumptions were regarding eliciting negotiability and physical interactivity whilst using the IWB.

4.5 Third Intervention

This intervention was based on the same activities of the second intervention, but this intervention took place in March 2011. Learners were alerted that they were to be formally assessed after the completion of the three lessons on all the aspects pertaining to the Processing module to encourage them to take the IWB activities seriously and limit off-task behaviour.

4.5.1 Lesson 1 Processing: Unjumbling Activity

4.5.2 Planning

In order to elicit additional *physical interactivity and negotiability* I decided to choose the *'Unjumbling sentences'.* Learners were given muddled data and they had to analyse it and unjumble the sentences and place them in the correct order. The lessons were exactly the same as the previous year's activities; the only difference was that instructions were added which stated that learners were supposed to read and work as a group in order to counter the off-task talking. Learners were informed that they would be formally assessed after the lessons. The emergent structure was used for this activity to optimise negotiability.

4.5.3 Implementation

Groups were once again given a hard copy of the instructions and they discussed amongst each other how the sentences should be structured. Learners went to the IWB and helped each other along as some of them struggled with dragging the words to the correct space in the sentence (See Figure 4.15).

4.5.4 Monitoring

4.5.4.1 Observer Schedules

A positive aspect noted with regard to negotiability is the “disagreement and arguing” that is crucial for negotiations to take place. A negative aspect noted with respect to physical interactivity is the fact that learners struggled to drag items on the IWB (Table 4.28).

Table 4.28 Observer Schedule Intervention 2 Lesson 1 Emergent Structure

Observer			Negotiability				Physical Interactivity	
			Positive		Negative		Positive	Negative
		Comment	Worked together /Active participation/ Negotiation/ Input given/engagement	lots of discussion/shared ideas /guided one another	Disagreement/ arguing	Unnecessary talking/Not contributing / laughing	Able to use IWB/Drag objects /Able to write on the IWB	Difficulty in dragging objects/Difficulty in using IWB pen
A	Group 1	Group discussion. Interactivity noted		✓			✓	
B		Learners were engaging with each other. Learners were able to manipulate the IWB.	✓				✓	
A	Group 2	Learners are talking about the given task. Discussing it. Learners went to IWB to do task on board.		✓			✓	
B		Discussion taking place. Some were giggling and tend to be playful. All were at the board. Assisting if their peers struggled		✓		✓	✓	
A	Group 3	Discussion taking place. Learners are dragging items on the IWB.		✓			✓	
B		Learners were arguing about the answers. Each one had an opportunity to work on IWB.			✓		✓	
A	Group 4	Some disagreement amongst group. Learners help each other at IWB.			✓		✓	
B		Discussion taking place. Disagreement over the chosen structure of sentence. Good manipulation of the IWB.		✓	✓		✓	
A	Group 5	Some are talking and not contributing. Some are struggling to write on IWB.	✓					✓
B		Learners were eager to start with task. One of them took the leader role and assign task to the rest of group. All of them were able to work on the board.	✓				✓	
A	Group 6	Good co-operation amongst group Good manipulation of IWB.	✓				✓	
B		Learner engagement taking place. The group took turns in manipulating the IWB		✓			✓	
A	Group 7	Learners are taking turns to give their input. All had opportunity to work on the IWB.	✓				✓	
B		Learners in this group were discussing and deciding what to do. Good manipulation of the IWB. All of them had a chance to go to the board		✓			✓	
A	Group 8	Discussing task. Learners work well on the IWB.		✓			✓	
B		Learners were excited. Engagement taking place amongst learners. Some had difficulty in dragging the items.		✓				✓

4.5.4.2 Journal

A positive aspect of negotiability namely "more interaction" was stressed during this lesson. "More physical interactivity" and "IWB manipulation" was noted when learners were working on the IWB (Table 4.29).

Table 4.29 Journal Entries for Intervention 2 Lesson 3

Comment	Negotiability		Interactivity	
	Positive	Negatives	Positive	Negatives
	More interaction		More interactivity IWB manipulation	
More negotiability was noted in the form of interaction amongst group members before they went to the IWB.	✓			
Physical interactivity on the IWB was noted in the form of learners maneuvering the facilities on the IWB			✓	
Evidence of interactivity can be seen in the photographs (See Appendix 4.7)				

4.5.5 Reflection

The observation schedules noted more positive aspects of negotiability. My journal noted negotiability was visible when learners were interacting and engaging. Additional physical interactivity was elicited when learners were manipulating the IWB.

The emergent structure elicited more negotiability due to learners being more relaxed. Changing my pedagogy by instructing learners to read more and work as a group in order to counter the off-task talking helped. Learners were informed that they would be formally assessed after the lessons and that caused less talking .The emergent structure was used for this activity to optimise negotiability.

Recommendations for the next lesson included switching to the imposed group structure to validate my findings regarding the impact it has on negotiability and physical interactivity and improve thereon. I decided to use the Mix and Match Activity to evaluate the previous findings with respect to negotiability and physical interactivity.

4.5.6 Lesson 2 Processing: Mix and Match Activity

4.5.7 Planning

For the Mix and Match lesson learners had to use the given data and they had to analyse it and match the item with the descriptor. The imposed structure was used for this activity to see if there is a possibility of eliciting more negotiability taking place within the teacher-directed group setting.

4.5.8 Implementation

Groups were once again given a hard copy of the instructions and they discussed the task.

4.5.9 Monitoring

4.5.9.1 Observer Schedules

The positive aspects of negotiability and physical interactivity were highlighted. A negative aspect pertaining to physical Interactivity was that some learners encountered difficulty in dragging items (Table 4.30).

Table 4.30 Observer Schedule Intervention 3 Emergent Structure

Observer		Comment	Negotiability				Physical Interactivity	
			Positive	Negative			Positive	Negative
			Worked together /Active participation/ Negotiation/ Input given/engagement	lots of discussion/shared ideas /guided one another	Disagreement/ arguing	Unnecessary talking/Not contributing / laughing	Able to use IWB/Drag objects /Able to write on the IWB	Difficulty in dragging objects/Difficulty in using IWB pen
A	Group 1	Good group work. Learners assist those who experience difficulty. Learners busy at the IWB.	✓	✓			✓	
B		Some learners are not participating. Others were working on their own. Learners were able to use the IWB.				✓	✓	
A	Group 2	Good group work Collaboration amongst group members. Some disagreement. Learners are talking about the task and deciding how to solve the problem. Learners take turns to work on the IWB	✓		✓		✓	
B		Learners in this group were sharing ideas. Competent clarify aspects to slow learners. Some learners had difficulty moving the items around. Others assist them	✓	✓				✓
A	Group 3	One of the learners is not participating in activity. Some are laughing. The others are busy with task The group went to the IWB and assisted each other.				✓	✓	
B		Some quarrelling amongst group noted. Discussion followed. Group at IWB-able to drag items around.	✓		✓		✓	
A	Group 4	Group busy discussing the given task. Learners were able to manipulate the IWB.		✓			✓	
B		Some learners are talking and not working in the group while others are trying to complete the task.		✓				
A	Group 5	Group eager to complete the given task. They were discussing the task. Learners are able to move items around	✓				✓	
B		This group worked well together. Each one was given a chance to work on the IWB.	✓				✓	
A	Group 6	They were discussing the task. Able to work on IWB. Learners assist those who are struggling with structuring the sentence	✓				✓	
B		Group is discussing the task. Group is assisting those who are struggling.		✓				
A	Group 7	Learners are communicating and taking turns to do the given instruction. Able to work on IWB.	✓				✓	
B		Group are working together and assisting each other. Some difficulty experience when moving words around.	✓					✓
A	Group 8	Good group work. Discussion amongst group members. Learners could manipulate the IWB.	✓	✓			✓	
B		Group is actively participating Sharing ideas. Learners were given a chance to work on the IWB.	✓				✓	

4.5.9.2 Journal

The positive aspects of negotiability "engagement and discussion "were noted. The positive aspect of physical interactivity specifically mentioned" IWB manipulation" (Table 4.31).

Table 4.31 Journal Entries for Intervention 3 Lesson 2

Comment	Negotiability		Interactivity	
	Positive	Negatives	Positive	Negatives
	Engagement /discussion		IWB manipulation	
Learner engagement/negotiability-learners were discussing the given task	✓			
Interactivity was noted when learners went to the IWB and dragged the items by matching it to the descriptor.	✓		✓	
Learners were noisy-but they were busy discussing and delegating the tasks. In some groups a leader would assign tasks to each member.	✓			

4.5.10 Reflection

The structure of the design as well as instructions given stipulated that learners had to read through a passage as a group and discuss as a group what they were supposed to do. The observations signify that learners were collaborating and assisting each other while they were working. Even though some were arguing, they were arguing about who must do regarding the given task. Negotiations amongst learners pertaining to the tasks were evident.

Physical interactivity is evident due to the wide variety of items in the Mix and Match box which enabled all the learners within each of the eight groups to manipulate and drag items to the yellow box that defined the preservation concept. This activity enabled all the learners of the group to go up to the IWB and manipulate it thereby encouraging more physical *interactivity* amongst learners.

The emergent structure contributed to a relaxed atmosphere which had a positive impact on learners working together in a learner-directed group structure.

The next lesson entailed the writing component and I was curious to see what effect the writing aspect would have on the physical interactivity and how it can be improved upon when learners are instructed to only use the IWB pen instead of their fingers.

4.5.11 Lesson 3 Processing: Flow Charts: Material & Tool Lists

4.5.12 Planning

Learners had to use the muddled data and they had to analyse it into a Material list and Tool list and thereafter create a Flow Chart (writing down details of how to make a meal using the materials and tools). The entire activity (analysis of Material and Tool Lists and Flow Chart) had to be done on the IWB. Each learner would be given a hard copy of the activity. The imposed structure was used during this activity in order to authenticate the findings of negotiability during the teacher-directed groups.

4.5.13 Implementation

A PowerPoint Presentation (See Appendix 4.8) outlined Activity 3 where it was expected of learners to create a meal and list the material and tools. Before learners could tackle the practical part of Technology Education of preparing the meal in class, they had to go to the IWB and do the analysis of the given consumables. They had to figure out which item fits under the Material and the Tool Lists (See Figure 4.11)

4.5.14 Monitoring

4.5.14.1 Observer Schedules

The positive aspects of negotiability and interactivity were highlighted. A negative aspect pertaining to the physical interactivity was that learners encountered difficulty in dragging the items on the IWB (Table 4.32).

Table 4.32 Observer Schedule Intervention 3 Lesson 3 Imposed Structure

Observer			Negotiability				Interactivity		
			Positive			Negative	Positive		Negative
		Comment	Worked together /Active participation/ Negotiation/ Input given	lots of discussion/shared ideas /guided one another	Disagreement/ arguing	Unnecessary talking/Not contributing / laughing	Able to use IWB/Drag objects /Able to write on the IWB	Assisting those who are struggling	Difficulty in dragging objects/Difficulty in using IWB pen
A	Group 1	Members are giving their input on what they are planning to do. Learners take turns to write on the IWB	✓				✓		
B		Learners seem more relaxed. Good working relationship. Each one worked on the IWB.	✓				✓		
A	Group 2	Learners are chatting about the task that they must do. Assistance given where needed. Able to work on the IWB	✓				✓		
B		Group work well together. Group assist learners who are struggling	✓					✓	
A	Group 3	Learners are reading the given instruction. Discussion followed. Learners are able to work on the IWB.		✓			✓		
B		One learner read and explained what should be done. Others listen and give their inputs. Learners are writing on the IWB	✓				✓		
A	Group 4	The group is sharing ideas about what they understand the task entails. Learners eagerly assist one another at the IWB.		✓			✓		
B		Each one in this group is reading. Discussion followed. Group is busy at the IWB		✓			✓		
A	Group 5	Learners are analysing work. Decide who must do the different tasks.	✓						
B		Learners are participating in discussion. Members offer assistance where needed. One struggled to write on the IWB		✓					✓
A	Group 6	Group guide those who are struggling. Group assists those who struggle with writing on the IWB.	✓					✓	✓
B		Discussion taking place. Group leader assigns tasks to each one in group. All were granted an opportunity to do their task on the IWB.		✓				✓	
A	Group 7	Good working relationship. Everyone is participating. Guidance given to those who are struggling.	✓						
B		Group work well together. Learners were able to write on IWB	✓					✓	
A	Group 8	Learners are eager to help one another. Learners are able to work on the IWB.	✓					✓	
B		All are participating in discussion. Each one worked on the IWB.		✓				✓	

4.5.14.2 Journal

My journal notes revealed the positive aspects pertaining to negotiability and interactivity was also noted (Table 4.33).

Table 4.33 Journal Entries for Intervention 3 Lesson 3

Comment	Negotiability			Physical Interactivity	
	Positive		Negatives	Positive	Negatives
	Assistance offered	Inter-action		IWB Manipulation	
Learners' assistance noted. Some learners were not good readers then the more competent readers would assist them. Those struggling were supported. Some task entailed writing on the IWB and in some groups they struggled to hold the IWB pen. In these instances the more competent would guide them to hold a pen correctly.	✓				
Good negotiability. Learners were interacting with each other and planning how they would do the task on the IWB.		✓			

4.5.15 Reflection

This lesson was well executed and sufficient data was collected. The lesson with the incorporated instructions elicited more negotiability and there was a decrease in the off-task chatting. More physical interactivity was mentioned in the observation schedules and journal notes.

Learners' responses to the focus group interviews and questionnaires showed that the imposed structure hindered learner engagement. It seemed that the mere fact that learners were alerted beforehand about the formal assessment after the intervention caused them to be more focused and less playful.

4.5.16 Learner Questionnaires

The responses to the question: ”How well did you work in your group?” indicated that forty-four percent of the 41 learners indicated that they worked quite well; 34% of the learners responded that they worked “good/well” in their groups and 22% reflected that they did not work well in their groups. The 22% is an indication that the imposed structure influenced learner engagement (Table 4.34)

Table 4.34 Learners' perceptions of how well they worked in the imposed group on the IWB

LQ1 IS3rd Intervention : **How well did they work in the imposed group**?		
Quite well	**Well**	**Not so well**
44%	34%	22%

The responses to the question: “How well did you work in your group?” showed that: 58% percent of the 41 learners indicated that they worked “well; 37% of the learners responded that they worked quite well in their groups and 5% reflected that they did not worked well in their groups. Overall learners worked well in the emergent structure and the 5% that did not work so well can be ascribed to the arguments and disagreements that occurred in the group (Table 4.35)

Table 4.35 Learners' perceptions of how well they worked in the emergent group on the IWB

LQ1 ES3rd Intervention : **How well did they work in the emergent group**?		
Quite well	**Good/well**	**Not so well**
37%	58%	5%

The responses to the question: ”Could you air your views in the group. Say freely what you feel?” produced the following findings: Forty-nine percent of the 41 learners indicated “yes”; 34% of the 41 learners responded “sometimes” in their groups and 17% said “no, ”which can be attributed to imposed group structure that tends to inhibit learners’ contributions (Table 4.36)

Table 4.36 Learners' perceptions of if they could you air their views in the imposed groups.

LQ 2ES3rd Intervention : **Could you air your views in the group. Say freely what you feel**?		
Yes	**Sometimes**	**No**
49%	34%	17%

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The responses to the question: ”Could you air your views in the group. Say freely what you feel?” revealed the following findings. Forty-nine percent of the 41 learners indicated “yes”; 39% of the 41 learners responded “sometimes” in their groups and 12% said “no”. In the emergent structure it is evident that learners could air their views, but the 12% “no” is an indication that learners were also limited to do so (Table 4.37).

Table 4.37 Learners' perceptions on if they could air their views in the imposed groups.

LQ 2ES3rd Intervention : **Could you air your views in the group. Say freely what you feel**?		
Yes	**Sometimes**	**No**
49%	39%	12%

Responses to the Question: ”Did you enjoy working as a group on the IWB?” showed that 41% of 41 learners indicated “yes”. Twenty-seven percent out of 41 learners responded with “sometimes” and 32% of 41 learners responded with a “no”. The 32 % “no” indication shows that the imposed group structure impedes their group work (Table 4.38).

Table 4.38 Learners' perceptions on if they enjoyed working as a group on the IWB?”

LQ 3 IS3rd Intervention : **Did you enjoy working as a group on the IWB**?		
Yes	**Sometimes**	**No**
41%	27%	32%

Responses to the question: ”Did you enjoy working as a group on the IWB?” indicated that 58% of 41 learners indicated “yes”. Thirty-seven percent of 41 learners responded with “sometimes” and 5% of 41 learners responded with a “no”. The overall positive response can be ascribed to the emergent group structure and the 5% negative responses can be attributed to the arguments and disagreements (Table 4.39)

Table 4.39 Learners' perceptions on if they enjoyed working as a group on the IWB?”

LQ 3 ES3rd Intervention : **Did you enjoy working as a group on the IWB**?		
Yes	**Sometimes**	**No**
58%	37%	5%

4.5.17Focus Group Interviews

The responses to the question: four out of eight mentioned “different /better than previous session,” and four learners mentioned that it was “enjoyable”. These positive aspects can be attributed to the physical interactivity of the IWB (Figure4.15).

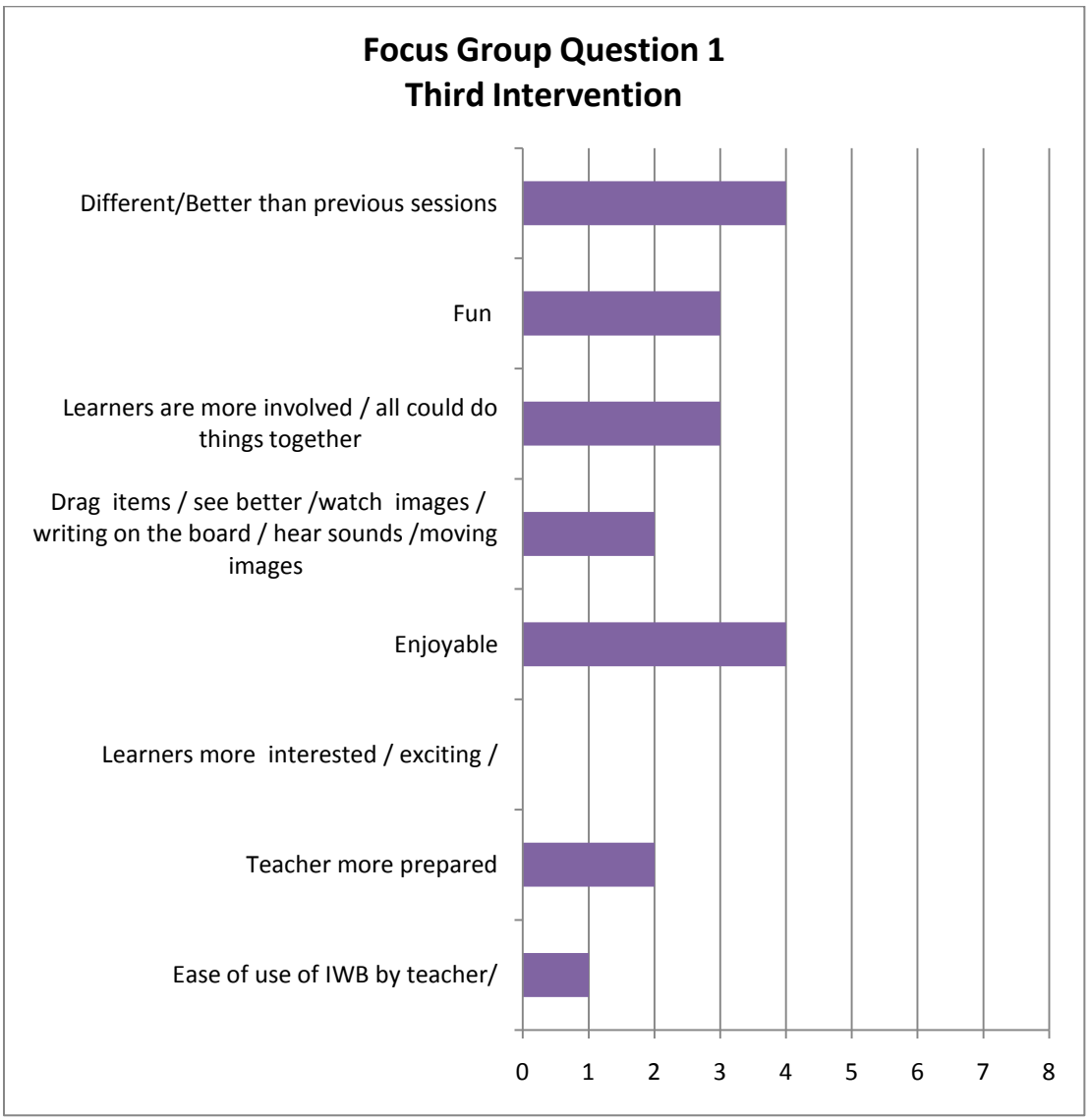

Figure4.15Learners' Responses to FGQ1

The responses to the question: six out of eight mentioned “Help each other/ and unjumble work as team/Group worked well” and this can be attributed to the positive impact that the emergent group structure has on group work (Figure 4.15).

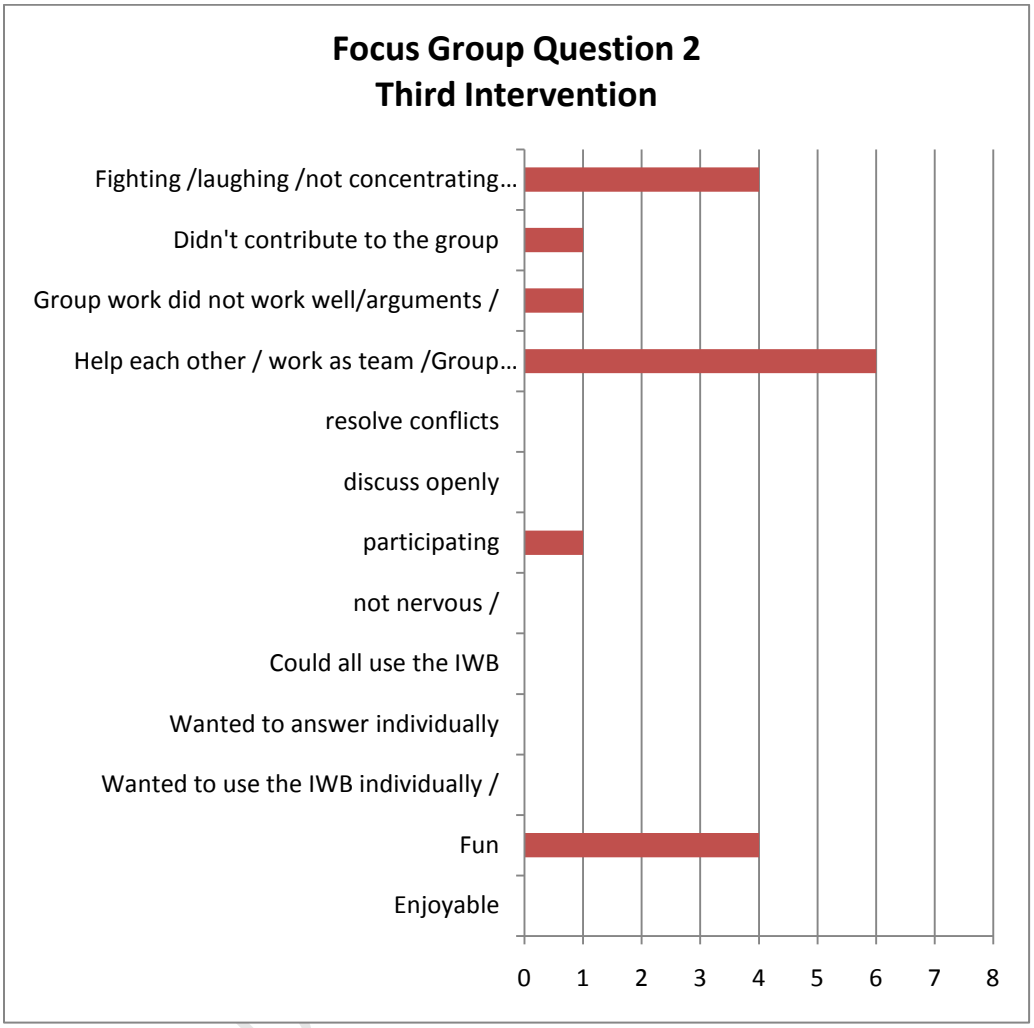

Figure4.15 Learners' Responses to FGQ2

Responses to the question: ”How did you find working in the imposed group?” showed that there was “No team work/no help”. Another two mentioned: ”not fun/not enjoyable” while working in the imposed structure. One said that he/she “Hated working without friends”. These responses were the dominant responses which indicate that the imposed group structure inhibited engagement (Figure 4.16).

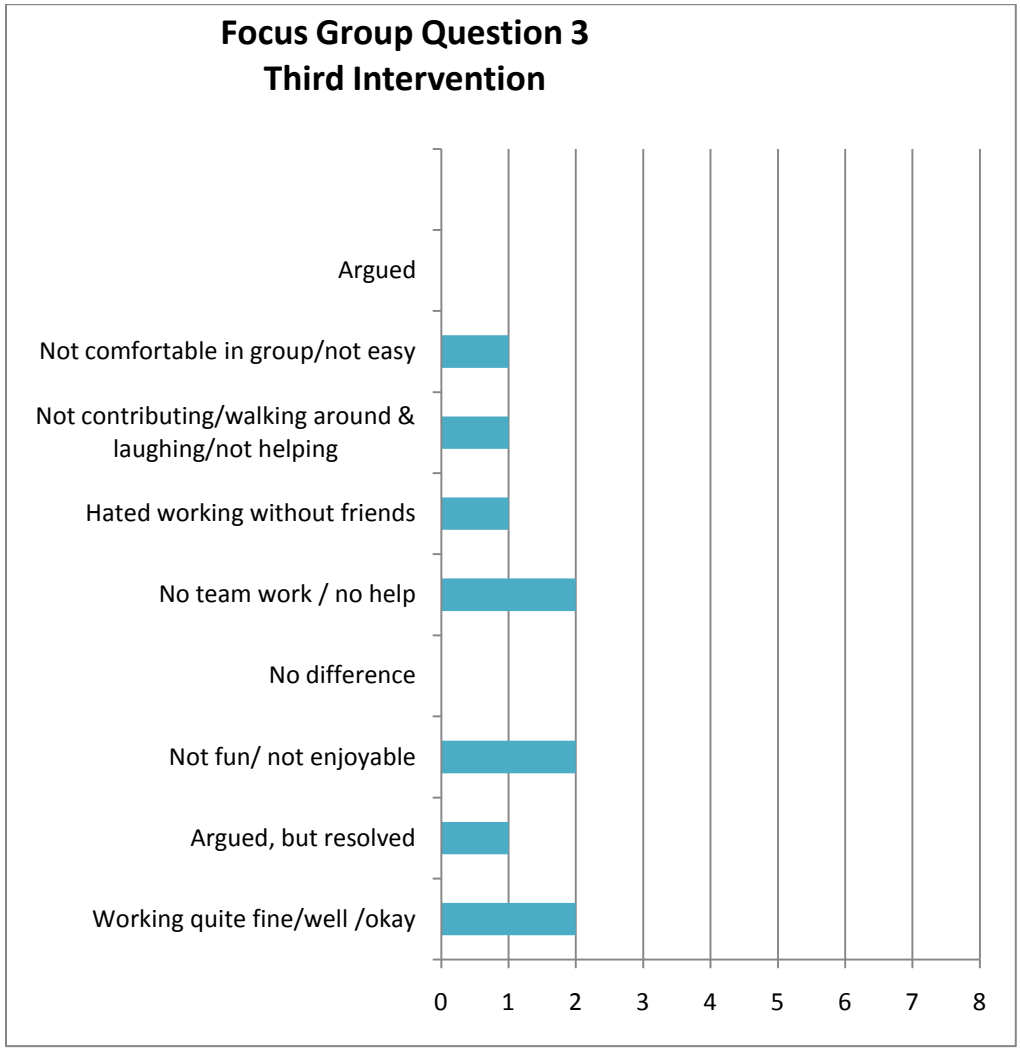

Figure4.16Learners' responses to FGQ3

4.5.18 Reflection on the third Intervention

More information was gathered during this intervention. This could be attributed to my noticing all the loopholes during the previous interventions. A vast improvement with regard to the implementation of the lessons, negotiability and physical interactivity as well as the collection of data occurred during this intervention.

Negotiability was elicited and can be attributed to the lesson design and instructions given to learners before the lessons as well as the type of group structure (imposed or emergent). The observers and I also noted how learners were discussing, sometimes arguing and disagreeing when they were engaging with each other in the groups.

Physical Interactivity was also noted and could be ascribed to the type of lesson design.

Group structures played an important role in the learner engagement. It was noted that the emergent structure encouraged more negotiability amongst the learners due to the relaxed atmosphere that prevailed. The imposed structure hindered learner engagement due to constant friction that occurred amongst the learners.

It was noted that when learners take charge of their learning that they are more focused and better behaved and this contributed to less off-task talking and more cooperation and learner engagement. The mention of a formal assessment at the end of an intervention also assisted with the above (Table 4.40)

Table 4.40 Matrix

			Collaborative learning	
			Negotiability	Physical interactivity
Pedagogical issues	Lesson design	Deliberate learner-centred lesson design focused on learners' activities	Generally encouraged negotiability	No direct influence
		Deliberate choice of activities to optimise use of IWB	No direct influence	Generally encouraged physical interactivity
	Group structure	Imposed group	Generally inhibited negotiability	No direct influence
		Emergent group	Generally encouraged negotiability	No direct influence
	Instructions	Explicit instructions on conducting discussion	Generally encouraged negotiability	No direct influence
		Minimal instructions on conducting discussion	Generally inhibited negotiability, encouraged? off-task activities	No direct influence
	Assessment	Explicit assessment task	Generally encouraged negotiability	No direct influence
		Implicit assessment	Generally inhibited negotiability	No direct influence
Technological issues	IWB Functionality/ Affordance	Single learner interaction – Template	No direct influence	Generally inhibited physical interactivity
		Multiple learner interaction – Adaptation of IWB tools	No direct influence	Generally encouraged physical interactivity

4.6 Summary

Eliciting negotiability amongst learners at work in class requires one to investigate the lesson design as well as the group structure.

During the first intervention the lesson designs on the Smart Board Toolkit hampered physical interactivity, but by modifying the design additional interactivity was elicited.

It was noted that the imposed group structure seemed to have a dampening effect on learner engagement within the groups and gave rise to friction in some instances. The opposite was visible when the emergent structure was in place. Learners were more relaxed and eager to work as a group.

Changes in my pedagogy were necessary in order to accommodate the IWB. Changes include modifying the lesson designs and also including more structured discussions and formal assessments to cut out the excessive disruptions and off-task talking.

Chapter 5 will outline how activity theory has been used to identify the tensions within the activity.

Chapter 5: Analysis using Activity Theory

5.1 Introduction

This chapter focuses on how third generation Activity Theory (AT) has been used to provide a lens through which to analyse the actions produced within the activity system.

5.2 Analysis of the activity system

The IWB has been implemented in a Grade 6 Technology Education class in a disadvantage area in the Western Cape. As a novice IWB-user I decided to do an Action Research study and use Activity Theory as a framework to interrogate what changes I need to incorporate in my pedagogy.

The key unit of analysis in AT is the activity system. The *outcome* of this activity system was the learners' understanding of the concepts in Technology and the *object* was to improve my pedagogy in order to use the IWB optimally to encourage collaborative learning among the learners – specifically negotiability and interactivity during the learning and teaching process. The *subject* refers to me, the teacher-researcher, whose agency or point of view is taken in the analysis of the activity. The activity of the *subject* is directed at the *object* and is *transformed* into *outcomes* with the help of *physical (the IWB)* and *semiotic tools (curriculum content, group discussion, classroom management and formal assessment).* The physical and semiotic tools mediated the outcome which were the lessons I devised to elicit negotiability and physical interactivity. Rules are explicit or implicit regulations that constrain actions and interactions and in this instance the *rules* referred to the *imposed and emergent group structures*. The community refers to the *learners.* The *division of labour* refers to how tasks are divided between community members (horizontally as well as the vertical division of power and status). Within the groups, leaders were assigned and discussions took place, as well as manipulation of the IWB. The teacher-researcher is also included in the *division of labour* due to my teaching tasks as well as my development of lessons for the IWB.

The implementation of the IWB (new technological phenomena) at my school (the activity system) caused a disturbance and tensions that gave rise to innovative attempts to *change.* Below is an analysis of the Activity System (Figure 5.1).

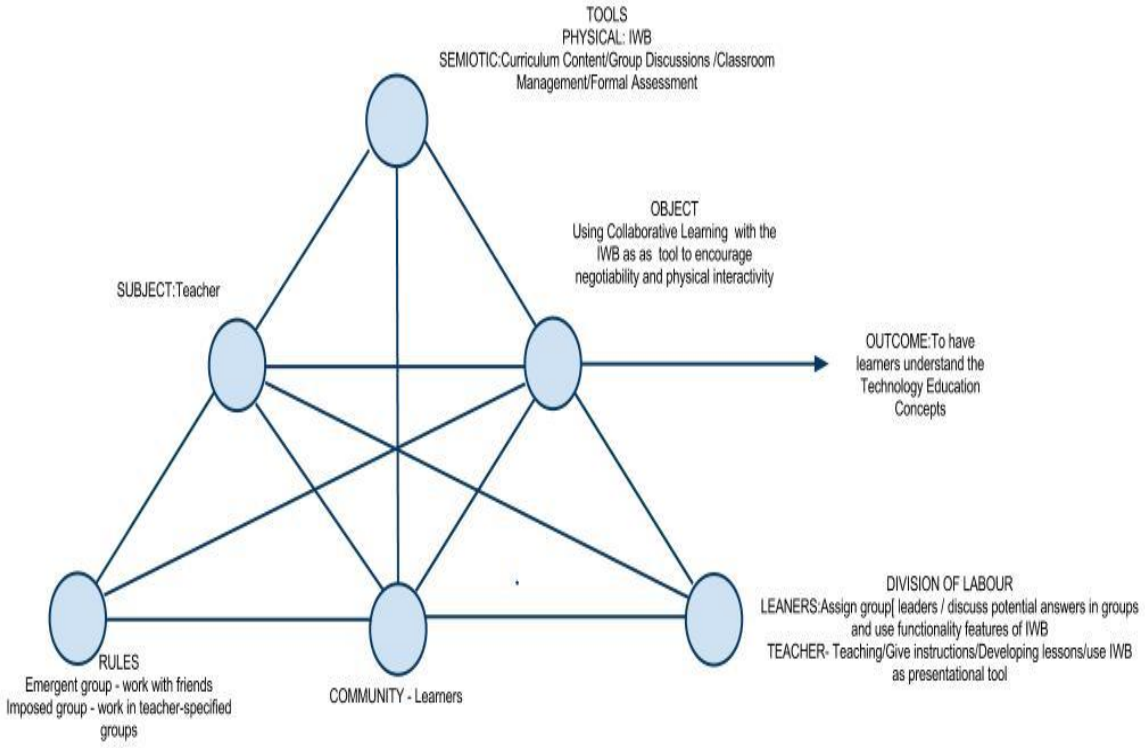

Figure 5.1 Representation of Activity System

5.3 Key Constraints

5.3.1 Subject-Tools-Object

The key source of tension originated from my lack of experience in using an IWB which I resolved by attending the basic IWB course in order to develop my technical skills. Another tension was my inexperience in using an IWB to encourage collaborative learning. Upon reflection of the first intervention, I noted during the first intervention that the lessons using the built-in toolkit on the Smart Board limited learners' physical interactivity. To counter the tension I had to find a resolution to the above tension and create my own lessons using the templates on the built-in tool kit and adapt them in order to elicit additional physical interactivity with the IWB. When analysing the key constraint, *Subject-Tools-Object,* the curriculum content (lessons) did not easily allow the *object (*physical interactivity) to be attained. A resolution would be to incorporate the *subject's (*teacher) skills to develop materials suited for IWB use that would encourage more physical interactivity.

With regard to the above-mentioned resolution, I share the same progression as the teachers who participated in Sweeney's (2010) investigation. They experienced a "break through" as they progressed along predictable patterns of development through the integration stage and transitioned from managing technology to enhancing student learning" (Sweeney 2010:32). Below is an illustration of the key constraints within the Activity Theory framework: Subject-Tools-Object (Figure 5. 2)**.**

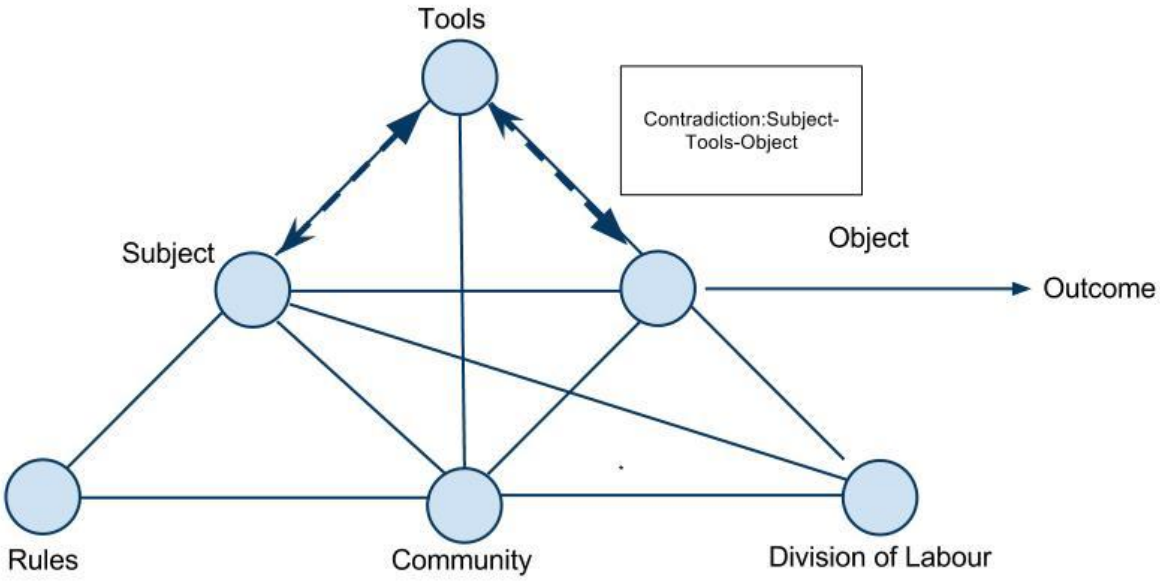

Figure 5. 2 Constraint: Subject-Tool-Object

5.3.2 Division of Labour-Subject

With the implementation of the IWB my role of teacher and the division of labour seemed to pose a tension due to the fact that the lesson templates on the resources toolkit did not produce sufficient *physical interactivity,* in contrast to the literature that suggests that the IWB can encourage technical interactivity (Tanner, Beauchamp, and Jones & Kennewell 2010). Thus it was required that new lessons be developed (the *lesson design* had to be adapted) in order to elicit more *physical interactivity* in order to successfully implement the IWB in my teaching. Apart from the adapted lesson design, I also had to implement strategies additional instructions in place in order to successfully incorporate the IWB in my class. This was evident during the first intervention and in reviewing my Action Research plan, these modified strategies were planned to be incorporated during the second intervention. Below is an illustration of the key constraint within the Activity Theory framework: Subject-Division of labour (**Figure 5. 3**).

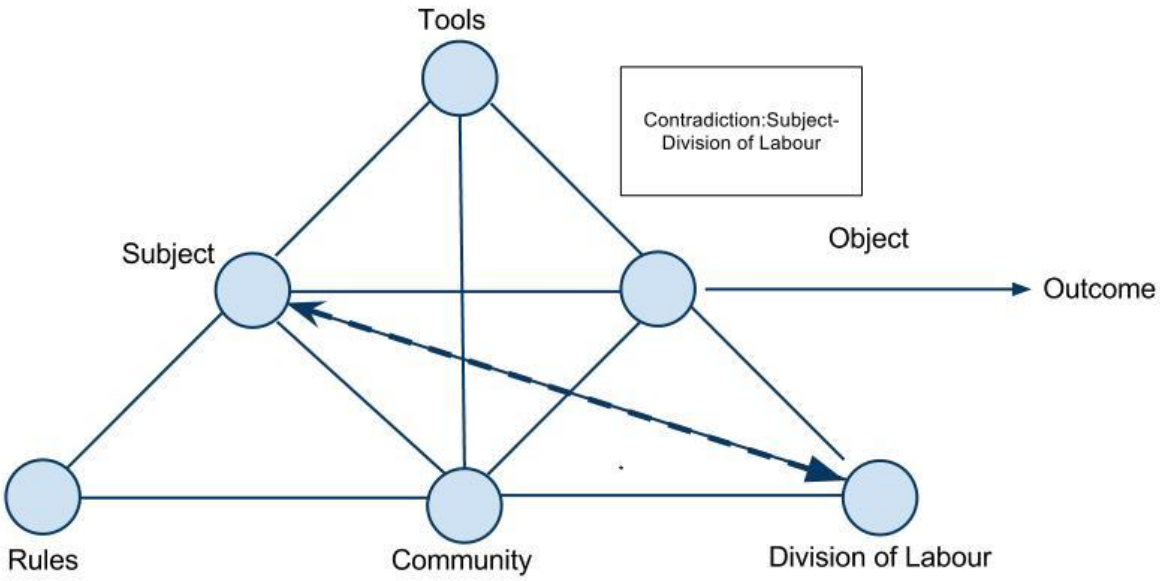

Figure 5. 3 Constraint: Subject-Division of Labour

5.3.3 Division of Labour-Community

Zevenbergen and Lerman (2008:122) mentioned that the roles of teachers and learners seemed to create tension between what is valued in existing teaching practices work-and what is offered by the IWB namely teacher-directed activity work where students are passive. The opposite was noted during my intervention because learners took charge of their learning by assigning group leaders, participating and discussing how they were going to solve problems in the negotiation phase. Thereafter they analysed the task by either determining which word fits the descriptor in the Mix and Match Activity or where a word should be placed in the Unjumbling activity and used the functionality of the IWB to complete the tasks.

Zevenbergen and Lerman (2008:122) mentioned the potential of a new division in digital labour to emerge where teachers are the more competent IWB users. During my investigation the opposite was noted. The learners were exposed to day-to-day usage of the IWB while I was new to using the IWB. My purpose with the investigation was to create a more *learner-centred* approach and place learners in charge of their learning. To support the learner-centred approach my pedagogical strategies had to be reviewed and modified in addition to this was done after the first intervention and implemented as a trial session during the second intervention. Furthermore the strategies were implemented in the third intervention again. Below is an illustration of the key constraint within the Activity Theory framework: Community - Division of labour (Figure 5. 4).

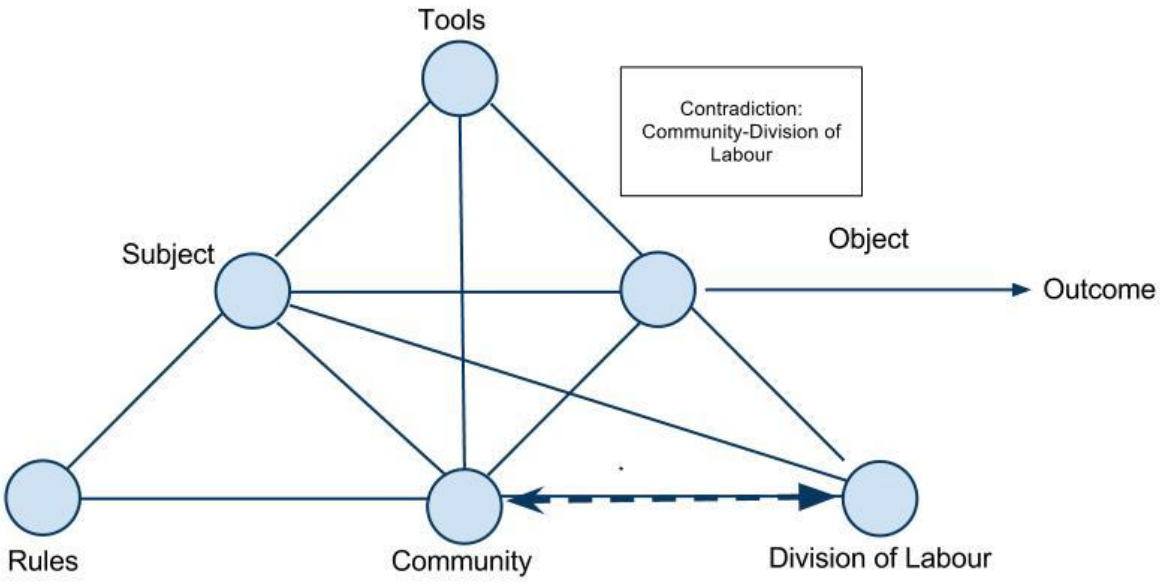

Figure 5. 4 Constraint: Community-Division of Labour

5.3.4 Tool-Object

With regard to physical interactivity the *Tool-Object* posed a tension. Thornley (2009:20) mentioned the following IWB affordances namely the "click and drag of objects, images and text", but the template (for the Mix and Match activity) on the built-in Toolkit of the Smart Board limited the *physical interactivity*.

Negotiability, which is also part of collaborative learning was not directly influenced by the use of the tool, but was more directly influenced by the teachers' pedagogical strategies including lesson design, instructions and assessment.

Sweeney (2010) mentioned the 'break-through' phase, which can be attained only when teachers are *technically* and *pedagogically* competent enough to be able to develop solutions that would counter the limitations that the IWB might pose. In order to overcome the barrier of limited *physical interactivity,* a pedagogical strategy was implemented and the *lesson design* was modified so that additional *physical interactivity* could be elicited. A resolution to this tension was to adapt the lessons and create a template that would allow sufficient physical interactivity. Below is an illustration of constraint within the Activity Theory framework: Tools-Object (**Figure 5.5**).

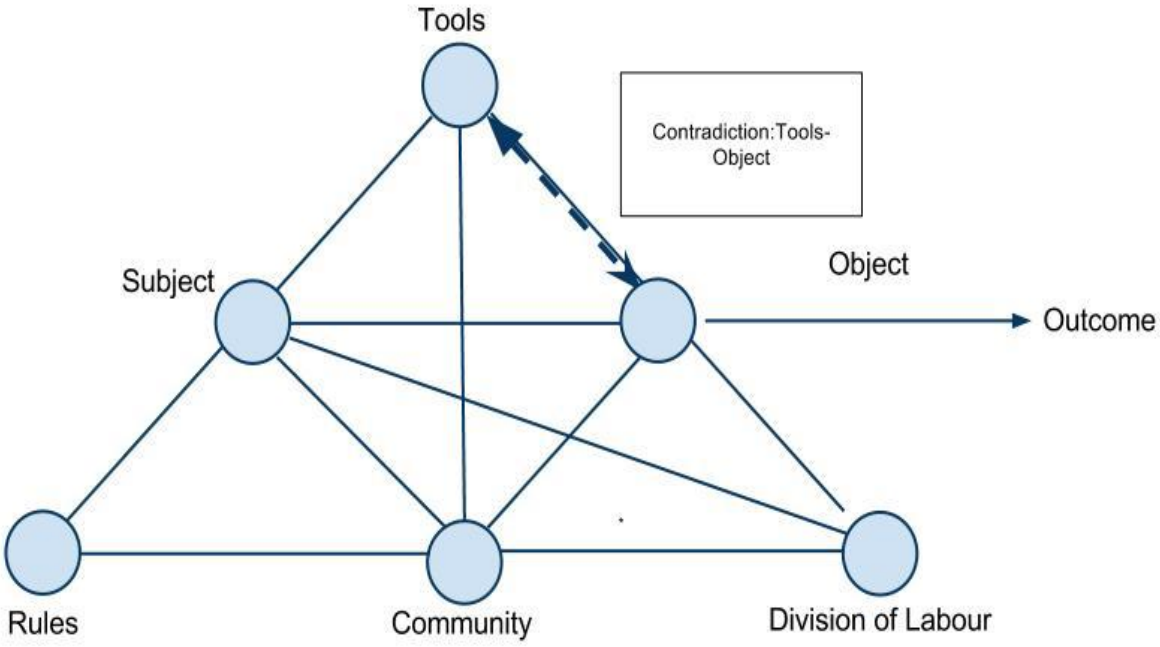

Figure 5.5 Constraint:Tools-Object

5.3.5 Rules-Community-Object

Incorporating *group structures* was part of structuring my pedagogy in order to reach the objective of this activity system, but learners did not comprehend what it meant to work in a group and this gave rise to tensions between the *rules-community* and *object*. In order to reach my objective in this investigation I had to review my pedagogy and implement the following. I changed the group structure to the most favourable structure namely the *emergent* structure in order to elicit additional negotiability. Learners were also given instructions, and they were alerted to the fact that they would be assessed at the end of the intervention. Below is an outline of constraint within the Activity Theory framework: Rules-Community-Object (**Figure 5.6**).

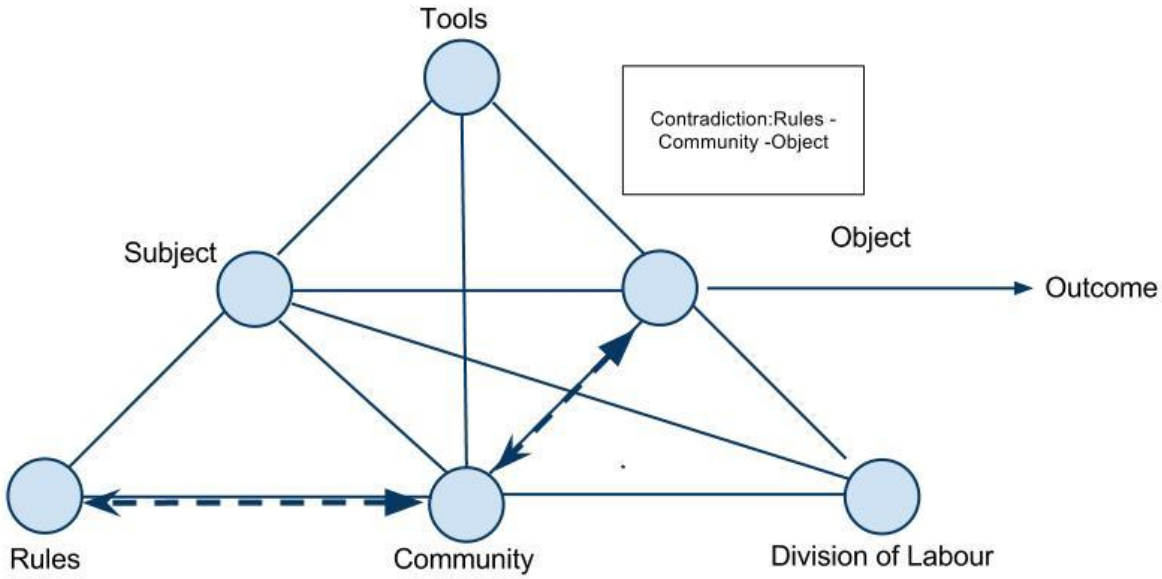

Figure 5.6 Constraint: Rules-Community–Object

5.3.7 Tool-Community-Object

The purpose of implementing the IWB in my teaching and converting to a more learner-centred approach gave rise to the following tension between the *Tool-Community* and *Object*. A resolution to this tension was to adapt the lesson design in order to create more physical interactivity and include more instructions for the learners. Below is an outline of constraint within the Activity Theory framework: Tools-Community-Object (**Figure 5.7**).

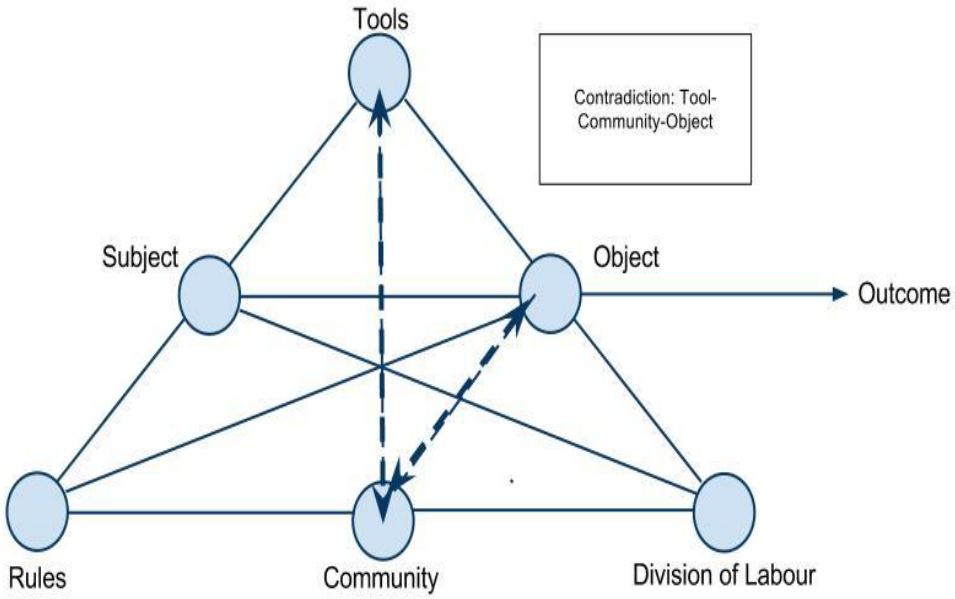

Figure 5.7 Constraint: Tools-Community-Object

5.4 Conclusion

The implementation of the technological tool (IWB) in the educational sphere goes hand-in-hand with the disruptions in the usual activity system and exposure of tensions. Engeström's Third Generation Activity Theory presented a framework in which to understand the tensions needed to be resolved. Resolutions to these tensions ought to be examined in order to find a suitable outcome.

Chapter 6 outlines the summarised findings, recommendations, further research identified and the concluding remarks.

Chapter 6: Summary, Recommendations and Concluding Remarks

6.1 Introduction

This chapter focuses on the summarised findings of the investigation and these will be discussed with reference to the literature. Resemblances and divergences with other studies are highlighted and areas requiring further research identified.

The objective of this study was to describe, evaluate and analyse how I need to adjust my pedagogy to optimise and support collaborative learning and specifically interactivity and negotiability in lessons using an interactive whiteboard in a primary school.

Educational researchers (Zevenbergen & Lerman 2008; Smith, Harman and Higgins 2006; Dillenbourg 1999 and Golub 1988) noted that using the IWB as a pedagogical tool promotes collaborative learning within the classroom. Slay, Siebörger and Hodgkinson-Williams' (2007) study in the Eastern Cape South Africa demonstrated the disruptive consequences that technology can have when not fully understood or used optimally and suggested instead that teachers be allowed to request the technologies they consider suitable to support their pedagogic needs. As a Technology teacher I attempted to use the IWB to enhance my pedagogy and encourage learner collaboration amongst my learners in the Technology Learning Area where no reported research with regard to IWB implementation has been undertaken in South Africa.

6.1.1 Collaborative learning - negotiability and interactivity

The implementation of a new technological tool in the classroom setting to encourage collaborative learning amongst learners will compel teachers to review their pedagogical strategies in order to optimise the use of the tool. The degree of collaborative learning was dependent on *negotiability* and *interactivity* among learners.

Negotiability was reliant on the instructions, type of group structure, lesson design and assessment. Likewise, *Instructions* with the given task influence the level of negotiability. Minimal instructions on conducting discussions limited negotiability whereas explicit instructions encouraged negotiability.

The overall group structure, i.e. emergent and imposed structures (Biott & Easen 1994) impacted on *negotiability* and *physical interactivity,* therefore the pedagogical strategies i.e. the two sets of interconnected concepts for collaborative learning i.e. *negotiability* and *interactivity* (Dillenbourg 1999) were used to encourage learner collaborative learning. Engeström's Third Generation Activity Theory

model (2000) was used to interpret the tension between the IWB, pedagogy and the curriculum (Zevenbergen & Lerman 2008). The *emergent* (child-initiated) structure elicited more negotiability amongst learners whereas the *imposed (*teacher-directed) structure limited negotiability.

Lesson design should be learner centred and focus on learner activities that could encourage negotiability. One critical lesson design was assessment. Implicit assessments inhibited negotiability, whilst explicit assessment tasks encouraged negotiability.

6.1.2 Physical Interactivity

Physical Interactivity was dependent on the IWB functionality and IWB affordance. The tools (lesson templates) on the IWB allows only for single-learner interaction which generally inhibit physical interactivity. Multiple learner interaction is possible with adaptation of IWB tools. When teachers employ pedagogical strategies to enhance the use of the IWB in classrooms, collaborative learning will be encouraged and the necessary negotiability and physical interactivity will be elicited. Below is an outline of pedagogical strategies employed to optimise the use of the new tool (**Figure 6.1**)

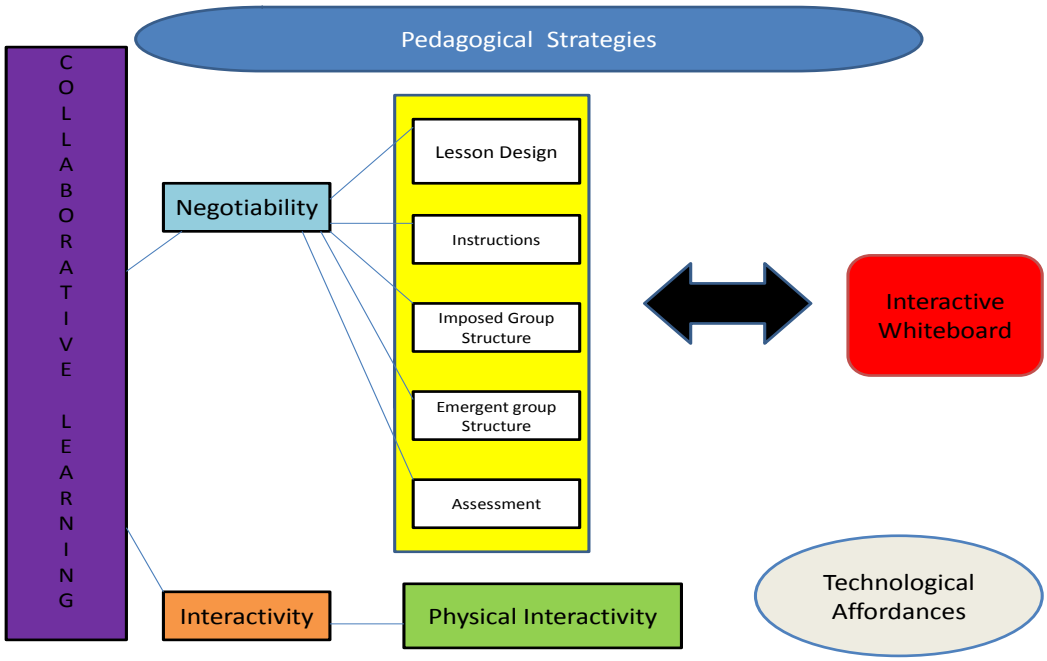

Figure 6.1 Conceptual map

6.2 Summary of Research Questions

6.2.1 To what extent does the use of the IWB encourage interactivity amongst learners?

This investigation has revealed that the use of an IWB to encourage *physical interactivity* among learners is dependent on the pedagogical strategies adopted by the teacher and the appropriate selection of functions of the IWB that allow for more than one learner to engage with the IWB at any one time.

6.2.2 To what extent does the use of the IWB encourage negotiability amongst learners?

This study has also revealed that *negotiability* amongst learners was more dependent on the pedagogical strategies adopted in the lesson (for example lesson design, group structure, instructions and inclusion of a formal assessment task) than on the functions (or affordances) of the IWB. It can be assumed that the use of the technological tool (IWB) does not directly encourage or discourage negotiability. Instead *lesson design* should be structured in a specific manner in order to elicit negotiability. The *emergent* group structure was the most favourable structure to elicit negotiability; whilst negotiability was hindered by the *imposed* group structure. It was also noted that it was important to include *instructions* with the task that would guide learners to work towards the intended objective. Another crucial aspect that encouraged a more focused approach to the task was the inclusion of a formal *assessment* at the end of the intervention and alerting learners to this requirement before the tasks were assigned to them.

6.2.3 To what extent does an imposed or emergent structure impact upon collaboration when using the IWB?

It was noted that pedagogical strategies implemented in the lessons (for example group structure) and not the functions (or affordances) of the IWB were crucial in eliciting *negotiability,* which in turn influenced collaboration when using the IWB. This study also revealed that *group structure* does not really influence the use of the IWB and its affordances. The use of the IWB had no direct effect on collaboration, but it was clear that the pedagogical strategies employed during the investigation encouraged collaboration amongst learners and *not* the use of technological tool.

6.3 Limitations and Challenges

Accepting a job offer in another province and having to move there during my investigation had implications for my studies. Due to this, I was forced to work with three different groups of learners.

Even though I attended a basic Interactive Whiteboard course, the training was insufficient because the course basically focused on using the affordances of the IWB and it did not prepare me to become technically and pedagogically savvy within the first few months of using the IWB. Neither did the course prepare me for developing suitable materials to address the need of eliciting additional *interactivity* as it was merely focused on encouraging users to use available built-in resources on the Smart Board.

Previous researchers assigned different meanings to concepts such as *interactivity* (Jewitt et al., 2007; Dillenbourg 1999) and this posed a problem in deciding which concept could be best aligned to my understanding of *interactivity.*

6.4 Recommendations

My study supports Sweeney's (2010) findings and she noted that teachers require a significant amount of assistance with the IWB in order to become technically and pedagogically competent (Sweeney 2010 citing Somekh, 2007). Teacher-researchers who intend researching their respective use of incorporating technological tools like the IWB in their teaching domain should therefore be experienced and knowledgeable about the limitations and possibilities of such tools and also be alerted to technical challenges which they might encounter while using the IWB.

Teachers require IWB-training on a continuous basis until they are confident and competent to use the IWB on a regular basis. Teachers should be encouraged to develop their own pedagogical materials while using the IWB this will enable them to experiment with a variety of lesson designs if the IWB templates do not suit their learning programme context.

They should also observe how other colleagues use the IWB and how they go about developing learner-centred materials suited for IWB use. Pedagogical strategies (i.e. lesson design, group structure, instructions and formal assessment) should also be implemented in the investigations that seek to employ the use of the IWB in educational environments.

6.5 Further Research opportunities identified

The basis has been laid for further research in using the IWB and its implementation in Technology education in the South African context. The following research possibilities could be investigated:

- A project that will support teachers to develop their own learning materials that incorporate all the affordances of the IWB.

- A study in the use of technology in classrooms in a disadvantaged area that will improve learners' attention span, interaction during lessons and their achievement.

6.6 Concluding Remarks

Evidence presented in this investigation consisted of observations, journal keeping, focus group interviews, and questionnaires regarding the IWB implementation in real classroom situations. Lessons observed during the first intervention limited *physical interactivity* and that could be linked to the limitations of the IWB (lessons on the Smart Board). It was evident during observations that lessons of the entire intervention were learner-centred, where learners took charge of their learning and the teacher facilitated the process.

The analysis of this investigation (see Chapter 4) indicated that Pedagogical strategies used during the investigation, such as lesson design, group structure, combined with instructions and assessment played an important role in encouraging collaborative learning amongst learners and that the IWB played no role in promoting collaboration.

I share the sentiments of Thornley (2010) about the prerequisites for infusing IWB technology in the classroom. She mentioned that IWB implementation in classrooms has to be underpinned by an understanding of how our teaching influences student learning as this will lead to teaching techniques that will utilise the IWB functionality efficiently, and in return will lead to a more profound learning experience for learners

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Appendices

Appendix: 3.1 Letter to the WCED

19 Geland Way

Grassy Park

7945

21 May 2010

The Director of Education

Head Office

Cape Town

8000

Dear Sir /Madam

Application for study leave

I am currently a part-time student at the University of Cape Town doing my Master's in Education (Information Communication Technology). I have completed the five modules, but due to the fact that I am teaching full time it is impossible for me to fit in the research

My research is based on the implementation of the Interactive Whiteboard and how the affordances of the IWB can be utilised optimally while learning and teaching is taking place.

Time required for my research intervention is set out as follow:

ACTIVITY	REQUIRED TIME
Consent Letters to WCED, Parents and school	July 2010
Developing suitable activities for the IWB tasks	July 2010
Research at school Observation of learners manipulating the	August 2010

activities on the IWB. Questionnaires for learners Video-taping learners Learners compile artifact using the IWB Journal writing Questionnaires to focus group	
Analysis of research	September 2010
Draft copy to supervisor	October 2010

Yours truly

Cheryl Jaftha (Mrs.)

Appendix: 3.2 Letter to School and Staff

19 Geland Way

Grassy Park

7945

4 August 2010

The Principal and Staff

Imperial Primary

Imperial Way

Beacon Valley

Mitchell's Plain

7785

Dear Principal and Staff

Permission required for research

I am currently busy with my M.Ed. Degree (Information Communication Technologies) at the University of Cape Town and require your permission to conduct my research at your school. The Action Research is to take place at Imperial Primary School while Grade 6 learners are being taught during Technology sessions. The period for my intended research will be from 16 August to 6 September 2010. The purpose of the research is to improve my teaching practice.

The research is based on how the Interactive Whiteboard can be used to encourage learner collaboration.

The research will take place during normal school hours and learners will be observed while they are using the Interactive Whiteboard. They will also be asked to complete a questionnaire based on their experiences.

Yours in Education

C.B.A Jaftha (Mrs.)

Appendix : 3.3 Letter requesting consent of parents for learner participation

4 August 2010

Dear Parents

Permission required for the research (grade 6A-learners)

I would like to inform you that I will be conducting a research exercise at Imperial Primary School from 16 August – 6 September 2010. I am currently busy with my Master's in Education degree (Information and Communication Technologies) at the University of Cape Town. The Action Research forms part of my minor dissertation and the purpose of the research is to improve my teaching practice.

The research is based on how the Interactive Whiteboard can used to encourage learner collaboration.

In order to do the investigation, your permission is required to allow your child to participate in the research. The research will take place during normal school hours and the learners will be observed while they are using the interactive whiteboard. They will also be asked to complete a questionnaire based on their experiences.

Please return the slip below to school and indicate whether your child will be allowed to participate in the research.

Yours in Education

C.B.A Jaftha (Mrs.)

.....cut off and return slip to school.....

Permission slip : indicate by making a circle

- **Yes. my child can participate in the research**
- **No, my child cannot participate in the research**

Parent's signature.....

Appendix 3.4 Learner Questionnaire

Circle the type of structure

Imposed / Emergent structure

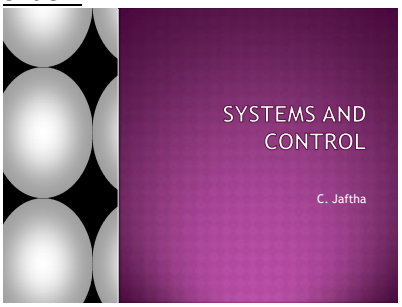
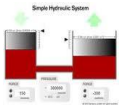
Please indicate by making a tick ( ) in the correct box

Question	Quite well	Well	Not so well
1. How well did you work in your group?			

Question	Yes	Sometimes	No
2. Could you air your views within the group/say what you want to say freely?			

Question	Yes	Sometimes	No
3. Did you enjoy working with your group on the IWB?			

Appendix: 4.1 Systems and Control PowerPoint

The following PowerPoint was based on Systems and Control and focussed on the types of mechanical systems and types of movement	Slide 1 
Slide 2 HYDRAULIC SYSTEM 	Slide 3 PNEUMATIC SYSTEM 
Slide 4 ROTARY MOVEMENT 	Slide 4 RECIPROCATING MOTION 
Slide 5 OSCILLATING MOTION  	Slide 6 LINEAR MOTION 

Appendix: 4.2 Hydraulics PowerPoint

The following PowerPoint was based on the Hydraulics and Pneumatics Module.

Slide 1

HYDRAULICS & PNEUMATICS

Grade 6
2010

Slide 2

EXAMPLES OF WHERE WE CAN FIND MACHINES THAT USES PNEUMATICS: SPRAY BOTTLES

Slide 3

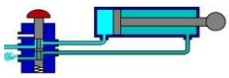
PNEUMATICS:DENTIST CHAIRS

Slide 4

HYDRAULICS : TIP TRUCKS

Slide 5

HYDRAULICS:PISTONS

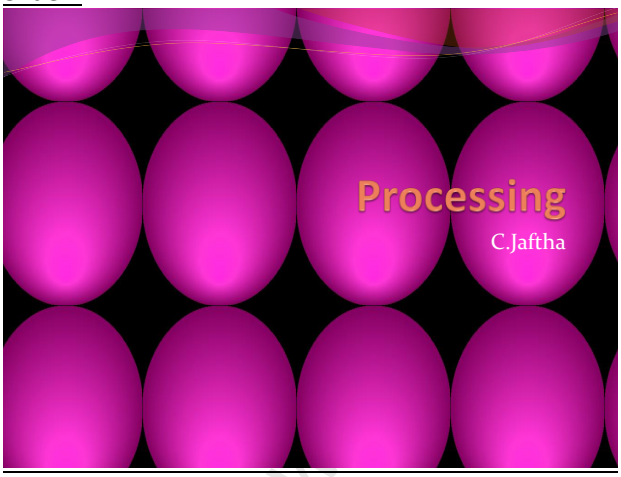


Appendix: 4.3 Learners at work on the IWB

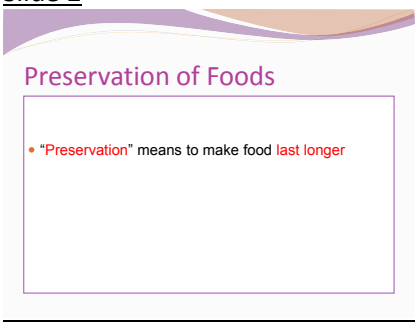
Appendix: 4.4 Processing PowerPoint (1)

The following PowerPoint was based on the Processing module.

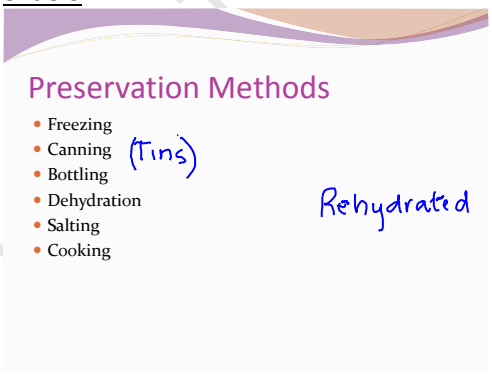
Slide 1



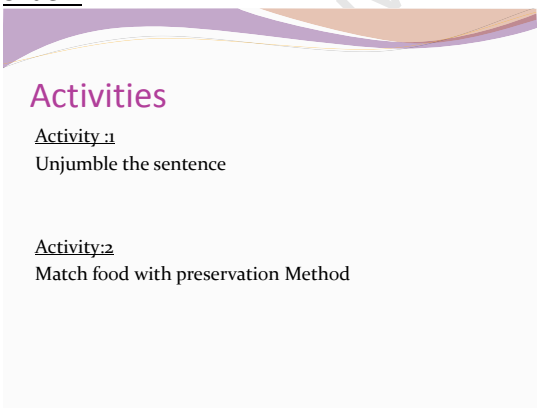
Slide 2



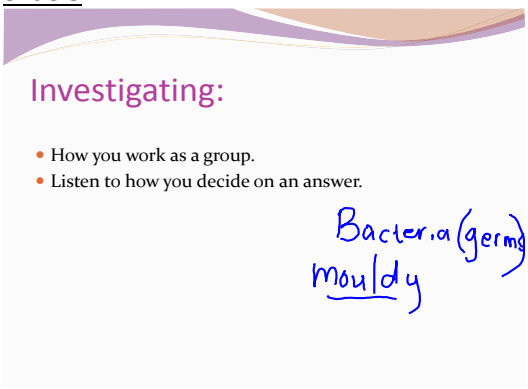
Slide 3



Slide 4



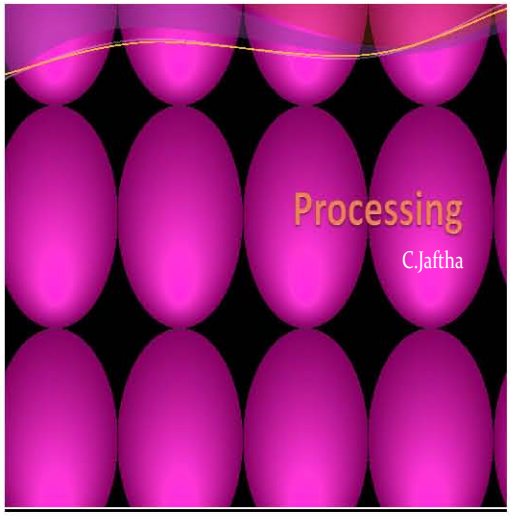
Slide 5



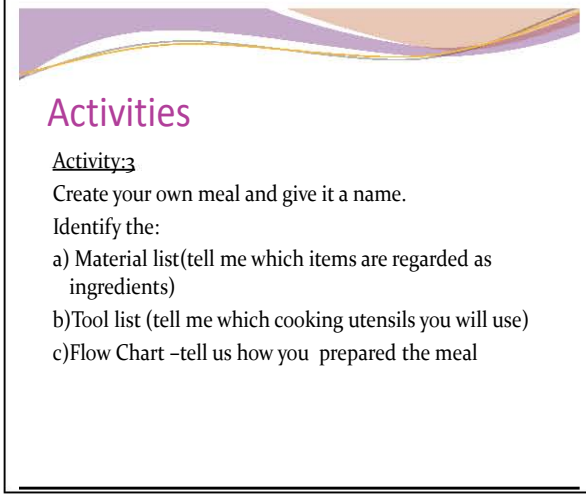
Appendix: 4.5 Processing PowerPoint(2)

The following PowerPoint was based on the Processing module.

Slide 2



Slide 2



Appendix 4.6 Coding of Interviews

Data source	Question How well did teacher present Technology using the IWB compared to the previous year's Technology sessions?	Response	Ease of use of IWB by teacher/	Teacher more prepared	Learners more interested / exciting /	Enjoyable	Drag items / see better /watch images / writing on the board /	Learners are more involved / all could do things together	Fun	Different/Better than previous sessions
FG Q1 L9		Miss used those other kinds of paper that was not easy to write on. Now you have an IWB that is actually good to be put on in and yah	1				1			
FG Q1 L 10		It was fun compared to the other um the previous year cos now you like more interested and the other was boring.					1		1	
FG Q1 L 11		It's much more better than the board	1				1			
FG Q1 L 12		The IWB is much more fun than the previous board because you can move					1		1	

		stuff.On the previous board you cannot.								
FG Q1 L 13		Umm yes that Miss um like on the normal white board you couldn't like drag the stuff and do that stuff and now you can you know	1				1			
FG Q1 L 14		Umm yea it was fun because because now Miss is prepared and sometimes in the old technology um Miss still had to write the stuff on .Now Miss just put the stick in and then the work is on the board	1				1		1	
FG Q1 L 15		Like in the previous year Miss had to explain it and we didn't catch it ,but now that Miss explain on the IWB we get it more the images more clearly.					1			